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THE UNIVERSITY OF ALBERTA

THE INFLUENCE OF PHYSICAL ACTIVITY ON SELECTED PSYCHOLOGICAL VARIABLES

by

CONNIE ELLEN McDONALD

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF ARTS

DEPARTMENT OF PHYSICAL EDUCATION AND SPORTS STUDIES

EDMONTON, ALBERTA

SPRING 1987

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To Rich

Thank you for your endless support

and enthusiasm.

You are my sunshine.

Abstract

The effect of two types of group exercise classes (aerobic and non-aerobic) was compared on changes in mood-state in sedentary females. The subjects were 43 females from the staff and student population at the University of Alberta. The two exercise groups were compared to a non-exercising control group on mood state changes before and after a nine-week training program. The results indicate there was a statistically significant change from time 1 to time 2 on 5 of 8 mood state variables. There was no evidence of a group effect or a group by time effect. On 3 of 8 variables, a non-statistically significant change occurred in the expected direction with the two exercise groups improving, while the control group showed no improvement.

The short-term effect of exercise on mood state was also measured by assessing mood state in the two exercise groups before and after a single exercise class. Results indicate that a statistically significant improvement on 6 of 7 mood state variables occurred after involvement in a single exercise class.

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I. Introduction

A. Background

Many health professionals, exercise enthusiasts, and psychotherapists believe that physical activity may have beneficial psychological effects. The potential role of physical activity in contributing to mental and emotional functioning is also of substantial interest in current research (Blumenthal et al., 1982; Brown et al., 1978; Ewing & Scott, 1984; Folkins, 1976; Griest et al., 1978; Hayden & Allen, 1984; Hilyer & Mitchell, 1979; Hughes, 1984; Hughes et al., 1986; Jasnoski & Holmes, 1981; Lichtman & Poser, 1983; Lion, 1978; McCann & Holmes, 1984; Monahan, 1986; Moreau, 1981; Morgan, 1985; Weinstein & Meyers, 1983; and Wilfley & Kunce, 1986).

Physical exercise is proposed to influence psychological functioning by such psychosocial factors as:

1. An increase in a sense of mastery. According to Hilyer (1979), physical activity engenders in the exerciser "an increased sense of control over self and the environment" (p. 434). A sense of accomplishment is a natural accompaniment to the feeling of having mastered a positive habit or skill.

2. An improvement in body image due to somatic changes such as a decrease in body fat and an increase in fitness which often accompany a systematic involvement in physical activity.

3. Diversion or distraction away from worrying thoughts while engaged in physical activity. Hughes (1984) states that "cognitive diversion has been proposed to mediate the anti-anxiety and antidepressant effects of exercise because subjects find it difficult to reminate about their problems when they are exercising" (p. 74). This time-out provides a rest from worrying and depression.

4. Social interaction or camaraderie that occurs in group exercise situations. Moreau (1981) was particularly concerned with the possible confounding influence of the effect of social interaction on the mediation of aerobic exercise and depression. People who have a low level of social interaction may benefit greatly from becoming involved in regular group exercise programs.

The proposed positive effects of exercise may also operate through physiological changes that might occur. Two predominant theories in this area include the endorphin and central amine hypotheses. The theory that exercising results in a release of endorphins (opiates) in the brain which accounts for the positive change in mood state lacks empirical evidence (Markoff et al., 1982).

Exercise has also been hypothesized to stimulate central amine responses such as the release of the neuro-transmitters serotonin, dopamine, and norepinephrine. Many treatments for depression, including anti-depressant medication, electro-convulsive shock therapy, and sleep deprivation enhance synaptic transmission of these neuro-transmitters (Ransford, 1982). While some animal research supports this viewpoint, Ransford states that . . .

> present statements that single out norepinephrine, dopamine, or serotonin as the crucial amine may be premature or over-simplified. Many more psychological and physiological studies must be performed in order to verify and quantify this relationship. (p. 1)

The role of physical activity in enhancing psychological functioning could be beneficial from both a clinical and a non-clinical viewpoint. Clinically, the use of exercise as an adjunct to psychotherapy in the alleviation of mood and personality dysfunction may have several advantages. These may include:

1. The non-pharmaceutical nature of exercise results in fewer negative side effects than pharmacological interventions.

2. Exercise is relatively inexpensive when compared to medical interventions.

3. Exercise has positive physiological side effects when practiced with due caution. Even if no psychological improvement occurs as a result of physical exercise, the physiological improvement may render the intervention useful.

As well as being helpful for clinical application, exercise may also improve psychological functioning in mentally healthy people. The focus of this study is on the non-clinical application of exercise to the 'normal' population.

Although a great deal of research has been done on the influence of exercise on psychological variables, few studies have been conducted to compare modes of exercise. The purpose of this study was to compare two types of exercise, aerobic and

non-aerobic, on changes in mood state in females.

B. Statement of the Problem

The purpose of this study was to investigate the following research questions:

1. What is the difference in depression and mood state scores between an aerobic exercise group, a non-aerobic exercise group (flexibility and muscular endurance), and a control group, after a nine-week training period?

2. What is the difference in mood state scores between an aerobic exercise group and a non-aerobic exercise group when measured before and after an exercise class?

Question one is hereafter referred to as Experiment #1. Question two was broken down into Experiment #2 which was conducted on the day of the first exercise class for both groups, and Experiment #3 which was conducted on the day of the last exercise class for both groups.

C. Hypothesis

1. Both the aerobic and non-aerobic exercise groups will show an improvement in depression and mood state over the nine weeks of training in Experiment #1. The control group will not improve. There will be no difference between the two exercise groups.

2. Both the aerobic and non-aerobic exercise groups will show an improvement in mood state as measured before and after a single exercise class in Experiments #2 and #3. There will be no difference between the two exercise groups.

D. Definition of Terms

Theoretical (T) and Operational (O)

Aerobic Capacity: (T) The ability of the body to transport and utilize oxygen (Fox & Mathews, 1981)

(O) As measured by the 8 minute modified Astrand submaximal bicycle protocol

Aerobic Exercise Group: (O) Exercise classes emphasizing improvement in aerobic

capacity

Depression: (O) As measured by the Beck Depression Inventory (BDI) short form

Life-Change: (O) As measured by the Life Events Survey (LES)

Mood States: (O) As measured by the Profile of Mood States (POMS) inventory

Non-Aerobic Exercise Group: (O) Referred to as the 'Stretch and Tone' group, these group classes consisted of flexibility and muscular endurance exercises.

E. Limitations

1. The use of a submaximal predictive test for aerobic capacity is not as accurate as a maximal Vo_2 test. Time and financial constraints were the primary reasons for choosing a submaximal test.

2. The number of subjects in each of the three groups is relatively small. This affects the power of the statistics to predict outcome. Unfortunately, the number of drop-outs in the study was beyond the researcher's control.

3. Experiments #2 and #3 do not have control groups. This weakens the applicability of the results as there is no control for the passage of time and test-retest effects. The test-retest effect would be demonstrated by an improvement in post-test scores in the control group due to the effect of the attention paid to the subjects by an experimenter.

4. The control group for Experiment #1 is not a true control group due to the non-random nature of assignment. Members of the control group were sedentary females who had no intention of beginning an exercise program.

II. Review of Literature

The review of literature pertinent to this study has been divided into several categories dependent upon the type of research design employed in the study. The categories include: Case studies, Before-After Non-Randomized Design, and Before-After Randomized Design. A summary of the review is provided in Table 1.

A. Case Studies

Blue (1979) conducted a nine week jogging program with two former inpatients at a psychiatric hospital after eight weeks of psychotherapy failed to alleviate their depression. The two subjects, one male and one female, jogged two to three times per week at the clinic. The male's depression scores on the Zung scale were reduced to mild from moderate, and the female from moderate to minimal at the conclusion of the study.

B. Before-After Non-Randomized Design

In the first phase of the Brown et al. (1978) Study, 96 women (mean age 19) and 71 men (mean age 24) chose one of nine conditions. Eight of the conditions were some type of physical activity; the ninth was a non-exercise control group. Three of the physical activities were competitive inter-varsity sport teams (wrestling, tennis, and softball). The other activities were all individual jogging programs that took place at various times throughout the year. Subjects completed the Zung Depression Scale, the Eysenck Personality Inventory, and Human Figure Drawings prior to and upon completion of the study.

All of the subjects exercised an average of 30 minutes a day, three days a week for ten weeks. The team players were supervised; the joggers were not supervised. Depression scores decreased significantly with wrestling, jogging, and to a lesser degree with tennis. There was no change in depression in the softball team members or the non-exercise control group. These results support the hypothesis that exercise has an antidepressant effect. However, the changes in fitness level as a result of the ten-week exercise intervention were measured by taking resting pulse rates, which is an extremely weak index of changes in aerobic functioning. This makes it difficult to

determine whether the changes in the depression scores were related to an actual change in aerobic capacity or to participation in the 10 week program. It is interesting to note that the softball team showed no change in their depression scores. This might indicate that social interaction was not a factor in this particular study.

In phase two of the same study, 561 university students chose to jog three or five times per week or to refrain from exercise for a ten week period (n=64). One hundred and one of the students were clinically depressed. Subjects completed a 12 minute Cooper run, the MMPI-Depression Scale, a confidential health questionnaire, the Activation-Deactivation Adjective Checklist, and a multifactor adjective checklist, plus the three inventories used in phase one. The results indicate that jogging for three or five days a week for a ten week period was associated with significant reductions in the depression scores of both the depressed subjects and the nondepressed exercise group. The subjects who did not exercise during the same interval had virutally unchanged scores. The authors of the study fail to report changes in the aerobic capacity scores as well as changes in the other inventories employed. It is also not known whether the joggers exercised alone, or in small groups. Therefore, the effects of social interaction are impossible to determine.

Jasnoski and Holmes (1981) attempted to determine: whether initial levels of aerobic fitness were related to differences in personality; whether participating in an aerobic training program was related to changes in personality independent of changes in aerobic fitness; and whether changes in aerobic fitness were related to changes in personality. The subjects were 103 female undergraduates (mean age 20), enrolled in a 15 week aerobics program. Cattell's 16 Personality Factors, a Self-Rating Depression Scale, the Type A Personality Survey, and the Cooper 12 minute test of aerobic capacity were administered prior to and following the 15 week exercise program. The group aerobic training sessions consisted of a one hour session, two times per week, plus additional individual aerobic exercise to total 30 aerobic points per week. The results indicated that initial levels of aerobic fitness, participation in an aerobic fitness training program, and changes in aerobic fitness were consistently related to reports of more positive personality functioning. Initial levels of fitness were related to greater self-assurance and emotional stability and less depression and pretentiousness.

Participation in the training program was related to increased self-assurance, imagination and easy-goingness, and less inhibitions and indications of coronary prone personality. Improvements in fitness were related to increased self-assurance, increased liberalness, and decreased tension. The identification of personality change as a result of exercise, independent of changes in fitness level is of particular interest. Many of the studies conducted in this area fail to control for the participation or social interaction factor. This study demonstrates that such an effect does exist, and could provide a competing hypothesis in studies that fail to control for the effect.

A matched control group was provided to control for the passage of time in the Blumenthal et al. study (1982). Sixteen subjects (11 women, 5 men) with a mean age of 45.1 years who registered for a 10 week adult fitness program participated in the study. The Profile of Mood States (POMS), the State-Trait Anxiety Inventory (STAI), a Retrospective Change Questionnaire, and a treadmill test were given to all subjects before and after the 10 week aerobic program. The exercise group met three times a week for 45 minutes of continuous walking or jogging to 70-85% of each subject's maximum heart rate.

The results indicate a significant decrease in Tension and Fatigue, an increase in Vigor, and a nonsignificant decrease in depression on the POMS in the exercise group. The trait and state anxiety scores of the exercise group were reduced significantly, while the control group showed no improvement.

The Retrospective Questionnaire results show that 66% of the exercise group indicated that their health improved, compared to only 16% of the controls. Sixty-one percent of the exercise group felt an enhanced sense of personal achievement, compared to only 27% of the controls. There was no significant change in sleep, eating patterns, or social life. Although a selection bias could account for the difference observed between the two groups, the results are nonetheless acceptable within the limitations of the design. Random assignment to the treatment and control conditions is desirable but not always feasible.

One of the few studies available that focuses on the short-term effects of exercise was done by Lichtman and Poser (1983). Thirty-two participants (male and female) enrolled in a physical exercise class at the 'Y' were compared to an equivalent

group of adults (mean age 25 years) who were enrolled in a hobby class offered by a community college. The participants of the experiment were randomly selected from within each self-selected class. Subjects were administered the Nowlis Mood Scale, Profile of Mood States (POMS), and the Stroop Colour and Word Test before and after their involvement in either the vigorous aerobic exercise class or the hobby class. The results of the Nowlis Mood Scale indicate that the exercise group felt significantly more elated, less sad, less serious or engaged in thought, less fatigued, less depressed, and more relaxed than the hobby group after involvement in the class. There were no significant differences as measured by the POMS scale. The results may have been confounded by the self selection of the participants to the groups, and by the fact that the exercise group attended a mean of 2.6 classes per week, whereas the hobby group attended a mean of only 1.5 classes per week. The selection factor is observed in the pre-test differences between the groups. The hobby group emerged as significantly more sad, angry, depressed, and engaged in thought than the exercise group before as well as after their hobby class. This may indicate that there are motivational and affective differences between individuals who choose to be involved in exercise as opposed to hobbies. Random assignment of the subjects to condition assists in controlling the bias of self-selection.

Wilfley and Kunce (1986) evaluated the physical and psychological benefits of an eight-week individualized exercise program for 83 "normal" adults. The subjects were not randomly selected as they were already signed up for an exercise program and agreed to take the psychological tests for research purposes. There was no control group involved in the study. The subjects were administered the Profile of Mood State inventory and the Physical Self-Concept subscale of the Tennessee Self-Concept Scale prior to and upon completion of the eight-week training program. Subjects trained for one hour, three times a week for eight weeks. The results indicate that statistically significant changes occurred in 4 of the 11 variables following completion of the exercise program. This included an increase in fitness and physical self-concept, and a decrease in the tension subscale of the Profile of Mood State inventory. While the other variables changed in a favorable direction, the changes were not statistically significant.

The absence of a control group and the non-random selection of subjects weakens this study.

Hayden and Allen (1984) conducted a study to overcome the methodological limitation of a failure to evaluate outcome through converging methods of measurement. Although they criticized the previous literature for a failure to randomly assign subjects to treatment, they followed a similar quasi-experimental design. The purpose of their investigation was to determine whether the beneficial effects generally reported by participants in various types of aerobic exercise are corroborated by knowledgeable informants. The 24 male and 74 female undergraduate volunteers self-selected into one of three groups: a) a sedentary group of 30 people, b) 34 active non-runners who exercised regularly, and c) 34 committed runners. The mean age of the subjects was 18.7 years. Prior to beginning the study, subjects filled out the State-Trait Anxiety Inventory (STAI), the Beck Depression Inventory (BDI), and a 48-item Committment to Running Questionnaire.

During the next seven days, the subjects kept a detailed log of the physical activity they engaged in. The senior author visited one knowledgeable informant nominated by the subject. The informant was asked to complete the measures as they believed the subject would, and to estimate the subject's typical level of exercise activity using the current week as an anchor.

The results indicate that runners were only distinguishable from active non-runners on those variables that pertained directly to running (i.e., committment to running, aerobic points earned by running). There was no significant difference between the two groups in terms of overall level of exercise activity, anxiety, or depression, as rated by themselves or their informants. The two physically active groups differed significantly in a positive direction from their sedentary peers on all variables. Corroboration of these differences by the informants followed the same pattern, but was not quite as consistent. The correlation between aerobic points and lowered trait anxiety was -.60. Self-reported depression on the BDI correlated -.47 with aerobic points.

Although these results replicate other investigations indicating that aerobic exercise enhances psychological functioning, the causal direction of the relationship

cannot be determined by the design of the study. It seems, however, that the subjective feelings of well-being associated with aerobic activity have observable social manifestations that are concurrently reported by roommates, spouses, and friends.

C. Before-After Randomized Design

A number of studies have investigated the relationship between aerobic exercise and psychological variables by employing the Before-After Randomized Design (Folkins, 1976; Griest, 1978; Hilyer, 1979; Moreau, 1981; Ewing, 1984; McCann, 1984; and Hughes, 1986). The random assignment of subjects to treatment and control groups enhances the internal validity of the study and should be done whenever feasible.

Folkins (1976) identified 40 males (age range 40-58) who were classified as high coronary risk subjects. They were matched by age, occupation, and risk factors, and assigned to either the exercise or control group.

The exercise group participated in three exercise sessions per week for 12 weeks. All subjects completed a treadmill test, the Anxiety and Depression scales from the Multiple Affect Adjective Checklist, as well as the self-confidence and personal adjustment scales on the Adjective Checklist prior to and upon completion of the study. Improvements in physical fitness were accompanied by significant improvements on two mood measures, anxiety and depression. No change was found on measures of adjustment, self-confidence, and body image. The control group showed no significant change on any of the psychological variables.

In one of the most often quoted studies, Griest et al. (1978) compared running as a treatment for moderate depression to two types of psychotherapy. Males (n=13) and females (n=15) between the ages of 18 and 30 were randomly assigned to either ten sessions of time-limited psychotherapy (n=9), which focuses on the immediate changes people can make to help themselves feel better; time-unlimited psychotherapy (n=7), which is usually insight-oriented, dynamic psychotherapy; or to running treatment (n=8).

The running group met two to three times per week and walked-jogged for 30-45 minutes. The time-limited psychotherapy consisted of ten sessions and the time-unlimited psychotherapy of a similar number. The measure of depression used by

the investigators was the symptom Checklist-90 for diagnosing minor depression. All of the subjects were classified as moderately depressed.

Six of the eight subjects who ran were essentially well within three weeks and remained well for the duration of the active treatment. These results compared favorably with those of patients in psychotherapy and persisted for at least one year in follow-up.

It is interesting to note that this study was published without any indication of the statistical methods used to assess the results. The bias of the authors is obvious as they are all runners. However, they do state that running is not a panacea and may actually increase depression if running becomes too painful and too competitive. The authors speculate that there will be some depressed patients who don't respond to running therapy because they don't follow the proper treatment prescription, or because their depression is atypical or unresponsive to this treatment method.

Hilyer and Mitchell (1979) conducted a study to investigate the effect of running and running plus counselling on the self-concept of college students. The subjects were randomly selected from students registered for a required course in physical education. There were 77 males and 43 females with a mean age of 20 years.

After filling out the Tennessee Self-Concept Scale, subjects were randomly assigned to one of three groups; control, running only, running with counselling. The running and counselling group met three times a week for one hour for 10 weeks. The counselling group met for an additional hour each week. The Cooper 12-minute walk-run test of aerobic capacity was given to both experimental groups. The counselling consisted of dealing with the interpersonal relationships that had developed within the group, discussing the problems and feelings encountered in the running program, goal-setting, and reinforcement of positive behavior, i.e., exercise and enjoyment of exercise.

The data for the study was divided into a high and low self-concept group. Both groups improved significantly in fitness scores. The greatest level of significant change in self-concept occurred among students in the low self-concept running/counselling group. This was followed by the low self-concept running group. The difference in the self-concept scores between the low self-concept running group and the control group

were not significant. This supports the hypothesis that running plus counselling is more effective than running without counselling in changing the self-concept of college students with low self-concepts.

The short-term effect of aerobic exercise upon affect and cognition was investigated by Ewing and Scott (1984). The 52 subjects (26 men and 26 women) were recruited and randomly assigned to either treadmill running or a non-exercising control group. The Profile of Mood States was used to assess the subjects' moods. Cognition was assessed by Rorschach and Holtzman inkblots. All subjects completed the psychological measures prior to being assigned to the exercise or control group. The exercise group jogged on the treadmill for approximately 10 minutes. Both groups were readministered the psychological tests half-way through the exercise session and 30 minutes after the exercise session. Results indicated that the exercise and control groups did not differ significantly in their overall scores for negative mood items during any stage of the study. When the positive mood items were analyzed, the exercise group produced a steady and significant increase in their scores while the control subjects showed a nonsignificant decrease in positive mood scores. The two groups did not differ on positive mood scores at pre-test. The exercise and control groups did not differ significantly on any of the measures of cognitive state during any of the experimental stages.

Moreau (1981) compared jogging as a treatment for non-clinical depression to a waiting list control, cognitive therapy and a naturalist program. The purpose of the naturalist program was to allow social interaction, an opportunity to learn about the outdoors, and a chance to be involved in a structured program that would not improve cardiovascular fitness.

Forty-eight housewives who were mildly depressed were randomly assigned to one of the four conditions. The groups were matched on their initial depression scores of the Beck Depression Inventory and their fitness scores on the bicycle ergometer test. Each of the three treatment groups met for exactly the same number of hours (19) for a duration of eight weeks. The exercise group followed a walk-jog program designed to progressively improve cardiovascular fitness.

The results indicated that jogging was not significantly more beneficial than cognitive therapy, than a field naturalist program, or even than membership in a waiting list control condition in alleviating depressive symptomology in a group of housewives. Moreau concluded that despite the results, the study did not provide conclusive evidence for the ineffectiveness of jogging in alleviating depression. The results were attributed to drop out levels in the field naturalist group, the poor quality of the leader of the cognitive therapy group, and the fact that the women weren't terribly unfit to begin with.

McCann and Holmes (1984) hypothesized that participation in a program of strenuous aerobic exercise would lessen depression in 43 women undergraduate students classified as mildly depressed by the Beck Depression Inventory. Subjects were randomly assigned to one of three conditions; aerobic exercise, relaxation training, or waiting-list control group.

The exercise group met twice weekly for one hour of walking/jogging in a group exercise class. The relaxation group was taught progressive muscle relaxation and instructed to practice 15-20 minutes/day, four days per week. All subjects completed the Cooper 12 minute walk-run test of aerobic capacity. The study was conducted for 10 weeks.

Analysis of the data indicated that the aerobic group improved significantly in aerobic capacity and decreased significantly in depression over both the relaxation and control group. There were no reliable differences between the latter two groups.

This study is one of the strongest designs published but its claims are somewhat exaggerated. It is still not known whether it is changes in aerobic capacity or involvement in a structured activity with an opportunity for social interaction that produced the resultant improvements in depression. Ideally, the relaxation group should have met for the same number of classes etc., as the aerobic exercise group. This would provide the much needed control for the competing hypothesis of social interaction.

Hughes et al. (1986) examined the effect of beginning an exercise program on the mood of sedentary men who were free of psychopathology. The fourteen male subjects were randomly assigned to a control or exercise period for 12 weeks, entered

a four-week 'wash out' period, and then entered the opposite condition for a second 12 weeks. The exercise consisted of five one-hour sessions per week of moderate intensity and was non-social in nature. Subjects were administered the POMS prior to and immediately following each condition. Data analysis indicates that the exercise group did not show a statistically significant improvement in VO_2 max despite the training program. As well, neither total mood disturbance nor any of the sub-scales of the POMS improved more during the exercise period than during the control period.

Despite the random assignment of subjects, to condition the small number involved in this study (n=14) weakens the reliability of the statistical analysis (repeated measures analysis of variance). Although Hughes et al. conclude that beginning an exercise program produces minimal psychological benefits, it is possible that with a higher number the authors would have found the expected increase in VO_2 max in the exercise group as well as a difference between the two conditions on the POMS.

D. Summary

Much of the research conducted in the area of the relationship between aerobic exercise and psychological variables suffers from methodological faults. The two most common faults are: a) a failure to randomly assign subjects to groups and b) neglecting to provide a control group for the passage of time and social interaction.

Although most of the studies reviewed provide supporting evidence for the hypothesis that aerobic exercise enhances psychological well-being, the evidence is slightly less convincing in the randomized-control group studies. The random assignment of subjects to conditions is essential to the internal validity of research in this area. The self-selection factor is demonstrated by Lichtman and Poser (1983) who found a statistically significant difference between the exercise and hobby group at pre-test. The difference may be due to motivational and affective differences between individuals who choose to be involved in exercise as opposed to hobbies. Self-selection of subjects into condition should be avoided for this reason.

A 'true' control group is also an important methodological consideration. A non-exercising control group that is randomly assigned is important for controlling for the passage of time. Without this control, it would be unknown whether an improvement

in the treatment group occurred as a result of the intervention or as a result of the simple passage of time.

In addition, a control group is needed to control for the competing hypothesis of social interaction. This group should meet for the same duration, frequency, and length of time as the exercising treatment group. The purpose of this group is to provide the same degree of social interaction that the exercise group receives. Without this control, any improvements the exercising group exhibits could be due to either social interaction or as a result of participating in physical exercise. Jasnoski and Holmes (1981) found that when initial fitness levels and improvement in fitness were disregarded, significant personality changes as a result of participating in the study occurred. Unfortunately, a control group was not included in the study.

All of the reviewed non-randomized studies show a significant increase in psychological functioning as a result of participating in physical activity (Blue, 1979; Brown et al. 1978; Jasnoski & Holmes, 1981; Blumenthal et al. 1982; Lichtman & Poser, 1983; Wilfley & Kunce, 1986; and Hayden & Allen, 1984). While this evidence is convincing, it should be accepted within the methodological limitations of the studies.

Of the seven randomized studies reviewed, five of seven authors reported a significant improvement in psychological variables after involvement in physical activity (Folkins, 1976; Griest et al., 1978; Hilyer & Mitchell, 1979; Ewing & Scott, 1984; and McCann & Holmes, 1984). Only one of the studies provided both of the necessary control groups. McCann and Holmes (1984) provided a relaxation group in addition to the aerobic exercise group and the control group. However, the relaxation group was not a valid control as they met for a shorter duration and frequency than the exercise group.

Moreau (1981) made an excellent attempt to satisfy the rigors of experimental validity by randomly assigning subjects to one of four conditions: wait-list control, cognitive psychotherapy, naturalist program, and a walk-jog program. All groups (except control) met for 19 hours over 8 weeks. It was found that jogging was no more beneficial than psychotherapy, a naturalist program, or the control group for alleviating mild depression. Moreau feels that the results were contaminated by poor quality of leadership in the psychotherapy condition, a high drop-out rate in the naturalist program,

and the fact that the subjects were physically fit prior to the beginning of the study.

Hughes et al. (1986), using a randomized cross-over design, found no significant improvement in either VO_2 max or mood state in the exercise group after 12 weeks of training. The low number of subjects (n=7) in each condition was possibly a contributing factor in the statistically insignificant results.

Overall, the evidence supports the hypothesis that psychological functioning improves with physical activity, both short-term (Lichtman & Poser, 1983; and Ewing & Scott, 1984), and long-term (Blue, 1979; Brown et al., 1978; Jasnoski & Holmes, 1981; Blumenthal et al., 1982; Wilfley & Kunce, 1986; Hayden & Allen, 1984; Folkins, 1976; Griest et al., 1978; Hilyer & Mitchell, 1979; and McCann & Holmes, 1984).

Table 1

Summary of Studies Conducted on the Effect of Exericse on Psychological Variables

Study	Population	Design	Measures	Outcome
Blue (1979)	2 former psychiatric inpatients living in a half-way house	Case study nine weeks of jogging, 2-3x/week	Zung depression scale	Male - scores changed from moderate to mild Female - scores changed from moderate to minimal
Brown et al. (1978)	561 university students 101 were clinically depressed	Self-selected into jogging 3-5x/week or control for 10 weeks	MMPI - depression scale Activation - Deactivation Adjective Checklist Zung Depression Scale Eysenck Personality Inventory Human Figure Drawings	significant reduction in depression scores of both depressed & non-depressed exercise group. No change in control group.
Jasnoski & Holmes (1981)	103 female undergraduates	Tested students who self-selected into 15-week aerobic exercise program (2x1 week)	Catell's 16 P-F Type A Survey Self-Rating Depression Scale	Participation in the program, disregarding changes in fitness level, resulted in increased self-assurance and easy-goingness, and decreased indications of coronary prone personality.

Blumenthal et al. (1982)	16 subjects, 11 women & 5 men	Matched control group to exercise group who self-selected into 10-week aerobic program (3x1 week)	Profile of Mood States State-trait Anxiety Inventory (STAI) Retrospective Change Questionnaire	Significant decrease in tension, fatigue, increase in vigor and non-significant decrease in depression (on POMS) for exercise group. STAI scores reduced significantly for exercise group, control no change.
Lichtman & Poser (1983)	32 males & females enrolled in exercise class at Y compared to equivalent group of adults enrolled in a hobby class	Self-selection. Compared mood state before and after a single class.	Nowlis Mood Scale POMS Stroop Colour & Word Test	initial difference between groups at pre-test, hobby group significantly more sad, angry, depressed. Post-test - exercise group was significantly more elated; less sad, fatigued, depressed than hobby group.
Wilfley & Kunce (1986)	83 adults, non-psychiatric sample	No control group Non-random selection of treatment group. Individual Aerobic exercise program for 1 Hour, 3x1 week for 8 weeks.	POMS Tennessee Self-Concept Scale	Significant increase in fitness, physical self-concept, and decrease in tension Non-significant improvements on all other variables

Hayden & Allen (1984)	24 male, 74 female undergraduate volunteers	Self-selected into: 1. Sedentary (n=30) 2. Active non-runners (n=34) 3. Committed runners (n=34) Purpose was to check if beneficial effects of exercise are corroborated by knowledgeable informants Study was conducted over 7 days, both subject & informant (subject selected) filled out the inventories The informant completed the inventories as they believed subject would.	State-Trait Anxiety Inventory Beck Depression Inventory	Both exercise groups differed significantly in a positive direction from sedentary group on all variables. Corrobation was similar. There was no difference between the two exercise groups.
Folkins (1976)	40 males (age 40-58) classified as high coronary-risk subjects	Matched by age, occupation, risk factors, and assiigned to control or exercise group which consisted of 3 sessions/week for 12 weeks.	Multiple Affect Adjective Checklist Anxiety & Depression scales	Significant increase in fitness, anxiety, & depression for exercise group. Control group showed no change.

Griest et al. (1978)	13 males, 15 females (age 18-30) All subjects classified as moderately depressed	Random assignment of subjects to: 1. 10 sessions of time-limited psychothrapy (n=9) 2. 10 sessions of dynamic psychotherapy (n=7) 3. Running 2-3x/week for 10 weeks (n=8)	Symptom Checklist - 90	No report of statistical analysis of data. Descriptive results indicate running is as effective as psychotherapy for treatment of depression.
Hilyer & Mitchell (1979)	77 males, 43 females (mean age 20) selected from students registered for a required course in physical education.	Random assignment of subjects to: 1. Running 3x/week for 10 weeks 2. Running/Counselling same plus one extra hour/week of group counselling 3. Control	Tennessee Self-Concept Scale	Significant increase in self-concept among students classed as low self-concept with running/counselling treatment, followd by low self-concept running group. No change in high self-concept groups or control group.
Ewing & Scott (1984)	26 men, 26 women recruited from university & community	Randomly assigned to either treadmill running (10 mins) or wait-list control. Measures taken pre, during, and 30 mins post-test.	POMS Rorschach & Holtzman blots	No difference between groups on negative mood items during any stage of study. Exercise group had significant increase in positive mood items while control group decreased. No change on cognitive measures.

Moreau (1981)	48 housewives classified as mildly depressed	Randomly assigned to: 1. Wait-list control 2. Cognitive psychotherapy 3. Naturalist program 4. Walk-Jog program Treatment groups met for 19 hours over 8 weeks.	Beck Depression Inventory	Jogging was not significantly more beneficial than psychotherapy, naturalist program, or control group.
McCann & Holmes (1984)	43 females, undergraduate students classified as mildly depressed	Randomly assigned to: 1. Aerobic exercise 2x/week (group) 2. Relaxation (individual) 4x/week 15-20 mins each time 3. Wait-list control Study was conducted for 10 weeks	Beck Depression Inventory	Aerobic group improved significantly in aerobic capacity & depression over both groups. No difference between relaxation and control group.
Hughes et al. (1986)	14 sedentary males, free of psychopathology	Random assignment to aerobic exercise (moderate intensity & non-social) or control for 12 weeks, 4 weeks 'washout,' and cross-over to opposite condition. Subjects served as own control.	POMS	No significant improvement in mood state for exercise group. No significant improvement in VO_2 max for exercise group.

III. Methods and Procedures

A. Subjects

Forty-three sedentary female students and staff from the University of Alberta participated in the study. Age ranged from 17 - 63 years. The subjects were not pre-screened for depression or aerobic capacity. They were pre-screened for previous involvement in physical activity. Only sedentary females (little or no physical exercise in the last six months) were permitted to join the study.

B. Measures

Beck Depression Inventory (BDI)

The short form of the Beck Depression Inventory was utilized due to time restraints. Although the original 21 item version is usually used in research, the 13 item short form takes much less time to fill out and correlates .96 with the original version (Beck & Beck, 1972).

The short-form BDI consists of 13 items that address current affective, cognitive, motivational, and psychological symptoms of depression. Although it was designed to measure depth of depression conceptualized as a continuum in a psychiatric population, it has been found to be equally valid for the same purpose in the general adult population (Oliver & Simmons, 1984). Each item consists of four statements in decreasing severity. More than one statement may be selected for each item, although only the highest score is recorded. The maximum total is 39 points. Subjects' scores are categorized as none or minimal, mild, moderate, or severely depressed (See Appendix A for copy).

The reliability and validity of the original BDI are acceptable. Beck notes that "studies of the internal consistency and stability of the BDI indicate a high degree of reliability while comparisons between the scores on the inventory and the clinical judgements by diagnosticians indicate a high degree of validity" (Beck et al., 1961).

Profile of Mood States (POMS)

The Profile of Mood States (McNair, Lorr, & Droppleman, 1971) is a factor analytically derived inventory designed to measure six identifiable mood states: Depression-Dejection, Vigor-Activity, Fatigue-Inertia, Anger-Hostility, Tension-Anxiety, and Confusion-Bewilderment.

The POMS consists of 65 questions on a 5 point Likert scale. The scale ranges from 0, (NOT AT ALL) to 4, (EXTREMELY). The instructions for the response period can be varied from "How you have been feeling during the past week including today" to "How you feel right now."

The POMS is self-scoring and usually takes between 3-5 minutes for the subject to complete. Both the reliability and validity of the POMS are acceptable. The internal consistency is .90 (McNair et al., 1971). The test-retest reliability is .65. Although this score appears somewhat low, it is expected. Mood state fluctuates and therefore low test-retest reliability is desirable. The six factor analytic studies conducted in the development of the POMS were congruent across samples and different rating time periods therefore supporting validity. Research has also provided evidence for the predictive and construct validity of the POMS. However, most (5 of 6) of the studies used in the development of the POMS involved psychiatric outpatients. The POMS is recommended for use on a research basis for normal subjects age 18 or older but data on the internal consistency of a normal population is not well documented (McNair et al., 1971). See Appendix B for copy.

Life Events Survey (LES)

The Life Events Survey (Sarason I, Johnson & Siegel, 1978) consists of 47 life events such as marriage, death of a close friend, trouble with in-laws, etc.

A 7 point Likert scale with a range from extremely negative to extremely positive is used to score each item. The LES provides both positive and negative life-change scores. An additional list of 10 events relevant to students is included.

The LES was developed to measure the individual impact of a life event that occurred within the last year. See Appendix C for a copy.

Aerobic Capacity

Aerobic capacity was predicted by a submaximal bicycle test. The protocol used in this study was the 8 minute modified Astrand bike test conducted by the University of Alberta Fitness Testing Unit.

The protocol involves two four-minute segments of pedalling, performed consecutively. The first four minutes of pedalling is done at 60 revolutions per minute and a power output of 50-60 watts (300 kpm's x .1634 [correction factor]). The purpose of this stage is to raise the heart rate of the subject above 120 beats per minute.

The second four minutes of pedalling is performed at 60 rpm's at a workload sufficient to achieve steady state in the subject's heart rate.

Maximum aerobic capacity was predicted from the Astrand Nomogram (Astrand & Rodahl, 1977). The formula involves age of the subject, body weight, final heart rate at eight minutes, and the power output for the final four minutes.

Qualitative Data

Upon completion of the study, subjects responded in writing to the following questionnaire:

1. As a result of participating in the exercise classes, did you notice any changes in the way you feel about yourself?
2. If yes, what sort of changes did you notice?
3. If you noticed any changes, how significant do you feel they were?

The results of the questionnaire are analyzed in a non-statistical descriptive manner.

C. Design

Experiment #1

	T_1 (January)	T_2 (April)
Group 1 Aerobics	S_1 - Sn	S_1 - Sn
Group 2 Stretch and Tone	S_1 - Sn	S_1 - Sn
Group 3 Control	S_1 - Sn	S_1 - Sn

Independent Variables

1. Groups, at three levels;
   a. Aerobic Exercise Group n = 7
   b. Stretch and Tone Exercise Group n=12
   c. Control Group n=6
2. Time, at two levels;
   a. Pre-test, January 27, 1986
   b. Post-test, April 4, 1986

Dependent Variables

1. Depression, measured by the BDI
2. Aerobic capacity, measured by the bicycle test
3. Depression, measured by the POMS
4. Vigor, measured by the POMS
5. Fatigue, measured by the POMS
6. Anger, measured by the POMS
7. Tension, measured by the POMS
8. Confusion, measured by the POMS
9. Profile of Mood State Total Score

Additional Measures

Life Events Survey and Qualitative Questionnaire.

Experiment #2 and #3

	T_1 (before class)	T_2 (after class)
Group 1 Aerobics	S_1 - Sn	S_1 - Sn
Group 2 Stretch and Tone	S_1 - Sn	S_1 - Sn

Independent Variables

	Experiment #2	Experiment #3
1. Groups, at two levels;		
a. Aerobic Exercise group	n=12	n=9
b. Stretch and Tone Exercise group	n=13	n=13

2. Time, at two levels;
   a. Pre-test, before class
   b. Post-test, after class

Dependent Variables

The six sub-scales of the POMS inventory:

1. Depression
2. Vigor
3. Fatigue
4. Anger
5. Tension
6. Confusion

plus the Profile of Mood States Total Score.

D. Treatments

Aerobic Exercise Group

Subjects in this group met for 45 minutes twice weekly to participate in a group exercise class. Each class consisted of a warm-up, 15-25 minutes of cardiovascular activities, and a cooldown. The classes were conducted indoors and were accompanied by taped music. The subjects were asked to participate in at least one additional aerobic work-out per week on their own time. A guideline exercise protocol and a journal to record the activity were provided for each person.

Stretch and Tone Group

Subjects in this group met for 45 minutes twice weekly to participate in a group exercise class. Each class consisted of a warm-up, 15-25 minutes of muscular endurance and flexibility exercises, and a cool-down. The classes were conducted indoors and were accompanied by taped music. The subjects in this group were asked to refrain from aerobic activities for the duration of the nine-week study.

Control Group

Subjects in the control group participated in the pre and post test conditions but agreed to refrain from physical exercise for the duration of the study. The control group was not utilized in Experiments #2 and #3.

E. Procedures

1. A "Women in Exercise Research Study" ad was placed in the Campus Recreation Winter Program Guide and the Gateway newspaper. Posters advertising the study were placed in several buildings around campus. The ad read, "participants will be randomly assigned to either a beginner aerobics class or a beginner stretch and tone class (without aerobics). The purpose of the study is to compare the effect of the two different exercise classes on psychological variables. All subjects in the study will receive two free fitness tests, a copy of the results of the study, and a reduced participant fee (half the regular cost)."

2. Subjects for the control group for Experiment #1 were recruited from campus. The control group was not randomly assigned as they had no intention of joining the exercise classes. They agreed to the pre and post-testing and to remain inactive for the duration of the study.

3. Subjects who joined the study were allowed to choose either M-W or T-TH from 1:00 - 1:45 P.M. as their exercise class. Once all subjects had joined, the researcher randomly assigned M-W as the aerobics group and T-TH as the stretch and tone group.

4. The same instructor taught both exercise classes. The classes were conducted at the same location, time of day, and frequency per week.

5. Subjects in the exercise classes were charged a $25.00 non-refundable fee to help cover the cost of fitness testing and class instruction.

6. Three separate experiments were conducted on the subjects. For ease of understanding, each experiment will be described separately.

7. In Experiment #1, subjects in the aerobic, stretch and tone, and control groups completed the following:

a. the bicycle test to predict aerobic capacity

b. Beck Depression Inventory (BDI)

c. Profile of Mood States Inventory (POMS)

d. Life Events Survey (LES)

e. Qualitative Questionnaire (QQ)

f. Physical Activity Readiness Questionnaire (PAR-Q) and Biographical Data.

The PAR-Q, biographical data, and bicycle test were completed prior to the start of the study.

Ten minutes before the start of the first exercise class, the subjects in the exercise treatment groups filled out the Beck Depression Inventory and the Profile of Mood States Inventory.

The subjects were then informed as to which exercise group they would be participating in. The control group filled out the BDI and POMS on the same days as the exercise groups.

The two exercise groups trained for nine weeks, from January 27 - April 4, 1986.

Ten minutes before the start of the last exercise class, the subjects in the exercise treatment groups filled out the BDI and POMS.

The control subjects filled out the BDI and POMS on the same days as the exercise groups.

Subjects from all three groups reported for a post bicycle test. Each subject completed a Life Events Survey and the subjects in the two exercise groups were asked to complete the Qualitative Questionnaire.

A letter thanking the subjects and explaining the hypothesis of the study was given to each person upon completion of the bicycle test.

8. In Experiment #2, subjects in the aerobic and stretch and tone group completed the Profile of Mood States Inventory.

. The POMS was administered prior to the first exercise class and immediately following the first exercise class. (The POMS in the pre-test is the same as the POMS #1 for Experiment #1.)

Subjects were not aware they would be asked to complete the POMS at the end of the class. There was no control group for Experiment #2.

9. In Experiment #3, subjects in the aerobic and stretch and tone group completed the POMS inventory before and after the last exercise class. The POMS in the before-class test is the same POMS used as POMS #2 in Experiment #1.

The subjects were not aware they would be asked to complete the POMS at the end of the exercise class. There was no control group for Experiment #3.

10. Experiment #2 and #3 were treated as separate experiments although they were conducted on the same subject pool. The number of subjects from Experiment #2 who also completed Experiment #3 is low. The aerobic group had eight subjects who completed both Experiment #2 and #3. The stretch and tone group had only five subjects who completed both Experiment #2 and #3. This low overlap was due to attendance fluctuations and to a problem that many of the subjects in the stretch and tone group in Experiment #2 incorrectly filled out the POMS inventory thus rendering the data unusable.

It was therefore decided that it was not plausible to compare Experiment #2 and #3 but to treat them as separate experiments.

F. Statistical Analysis

The statistical analysis used was a two-way analysis of variance (ANOVA) with repeated measures on the dependent variables.

Experiment #1 was analyzed as a 3 (Groups) x 2 (Time) ANOVA with repeated measures on the dependent variables. A one-way ANOVA between groups with the Life Events Survey as the dependent variable was also completed.

Experiments #2 and #3 were analyzed as a 2 (Groups) x 2 (Time) ANOVA with repeated measures on the dependent variables.

IV. Results

The results of the three experiments will be discussed separately.

A. Summary of Results: Experiment #1

Experiment #1 involved three groups (Aerobic, Stretch and Tone, and Control), measured at time 1 (January), and time 2 (April), and compared on changes in aerobic capacity and mood state. The subjects were females recruited from the University of Alberta campus. The hypothesis for Experiment #1 stated that both the aerobic and non-aerobic exercise group would show an improvement in depression and mood state over the nine weeks of training with the control group showing no improvement.

The data for Experiment #1 was analyzed by a two-way analysis of variance procedure (ANOVA) involving 3 groups X 2 times, with repeated measures on the dependent variables.

Experiment #1 involved 25 subjects; Aerobics (n=7), Stretch and Tone (n=12), and Control (n=6). The Aerobics group was composed of 5 students (71%), 1 staff (14%), and 1 person classified as both staff-student. The Stretch and Tone group had 8 students (66%), 3 staff (25%), and 1 person who was retired (8%). The control group was made up of 5 students (83%) and 1 staff (17%). All three groups appear relatively similar in age, occupation, and attendance levels (See Table 2).

From the total n of 25 for Experiment #1, 18 subjects were students (72%), 5 were staff (20%), and 2 were classified as other (8%).

There was no significant difference between the three groups on the Life Events Survey (LES) scores at the .05 level of probability. The LES was administered during the post-testing of all subjects for the purpose of determining the impact of life events over the past year.

Table 3 provides a summary of the raw scores for the data collected in Experiment #1.

Table 2

Characteristics of Subjects in Experiment #1

	mean age (years)	occupation	mean attendance for fitness classes
Group 1	29.6	5/7 (71%) students	87.1%
Aerobics		1/7 (14%) staff	
(n=7)		1/7 (14%) both	
Group 2	31.3	8/12 (66%) students	83.3%
Stretch and Tone		3/12 (25%) staff	
(n=12)		1/12 (8%) retired	
Group 3	26.7	5/6 (83%) students	N/A
Control		1/6 (17%) staff	
(n=6)			

Table 3

Summary of Results for Experiment #1

Variable	Pre (January)		Post (April)	
A. Aerobic Capacity	Mean	S.E.M.*	Mean	S.E.M.
1. Aerobics	34.47	2.76	37.35	2.58
2. Stretch and Tone	33.71	3.11	30.16	1.95
3. Control	29.45	2.07	27.93	1.98
B. Beck Depression Inventory	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	4.38	1.55	1.75	.72
2. Stretch and Tone	3.50	1.68	2.92	1.04
3. Control	2.67	.88	1.50	.43
C. POMS - depression	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	8.75	2.97	3.00	.81
2. Stretch and Tone	6.17	1.65	6.00	2.00
3. Control	8.67	3.40	6.17	1.45
D. POMS - vigor	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	15.50	2.17	16.40	1.82
2. Stretch and Tone	14.50	1.59	15.92	1.46
3. Control	16.33	1.98	15.50	2.25
E. POMS - fatigue	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	9.75	1.75	6.50	1.64
2. Stretch and Tone	7.83	1.65	6.50	1.28
3. Control	8.83	2.78	10.50	3.58
F. POMS - anger	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	9.75	2.39	2.50	.49
2. Stretch and Tone	5.60	1.30	3.33	.97
3. Control	10.50	3.26	7.33	1.69
G. POMS - tension	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	10.88	2.18	7.88	1.44
2. Stretch and Tone	9.17	1.79	7.75	1.44
3. Control	11.00	2.49	11.67	1.41
H. POMS - confusion	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	7.13	1.67	4.63	.78
2. Stretch and Tone	6.50	1.02	5.60	1.07
3. Control	8.17	1.53	6.83	1.4
I. POMS - total score	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	30.76	11.23	8.13	4.89
2. Stretch and Tone	20.75	7.18	13.25	6.28
3. Control	30.83	11.77	27.00	6.64

* Standard Error of the Mean

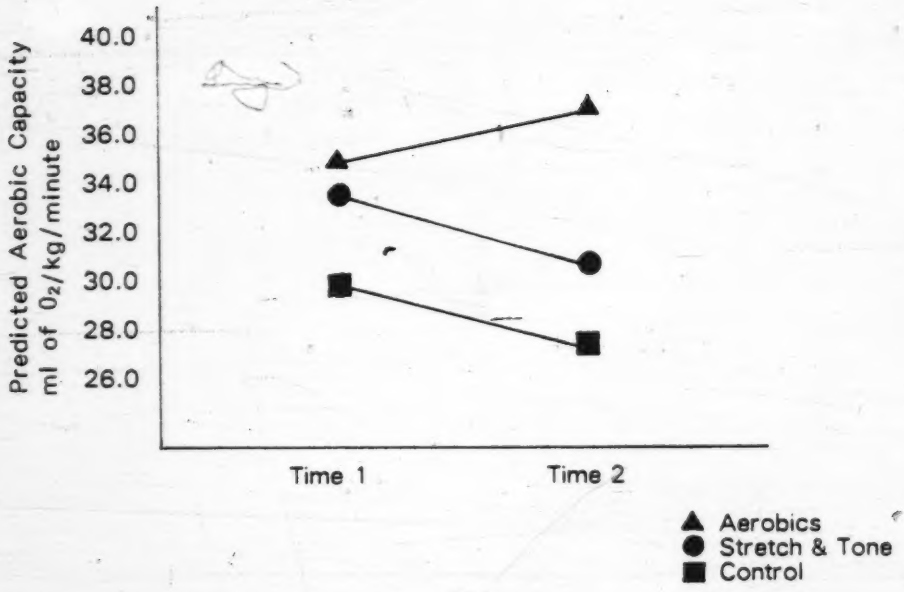

Figure 1. Results of Aerobic Capacity for Experiment #1

Aerobic capacity improved in the Aerobic group (34.47 to 37.35), and decreased in both the Stretch and Tone group (33.7 to 30.16) and the Control Group (29.45 to 27.93). Although the ANOVA procedure does not indicate a statistical significance for these changes (see Table 4), Figure 1 does illustrate the expected trends.

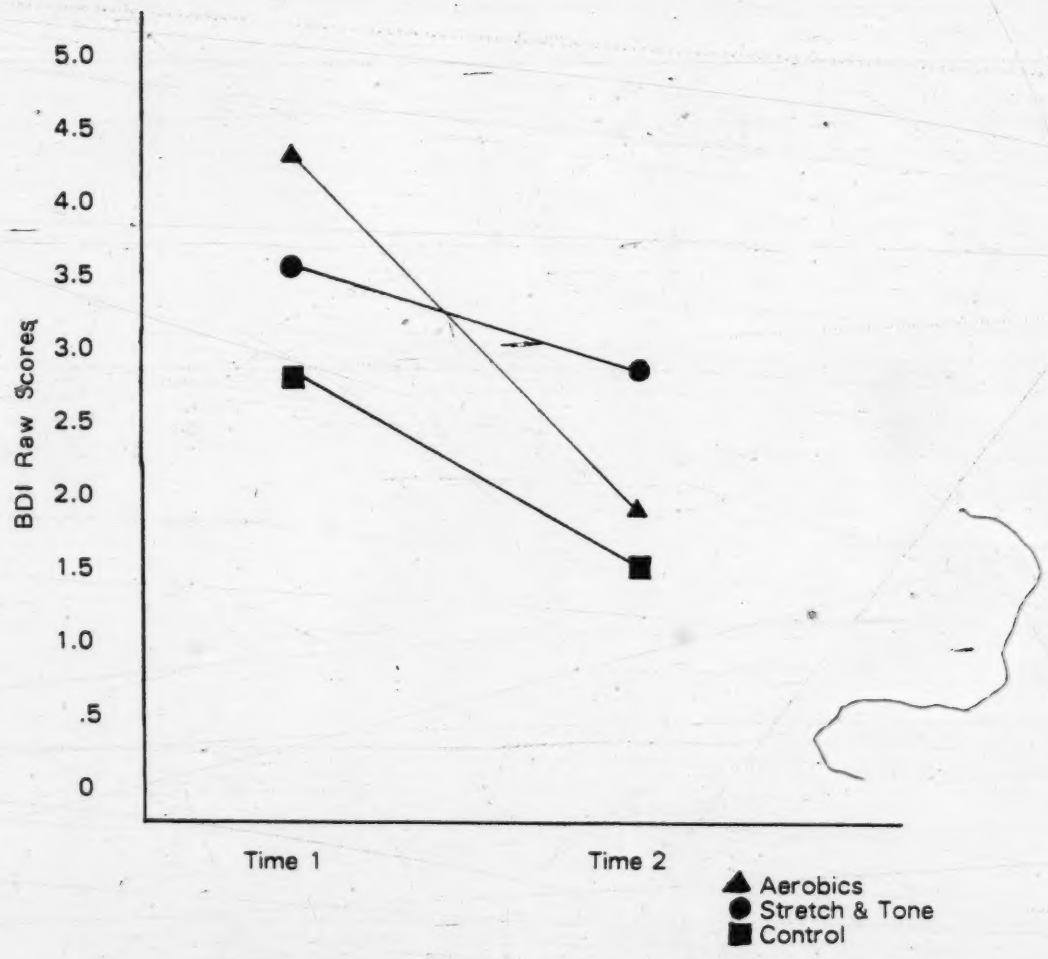

Figure 2. Results of the Beck Depression Inventory

Both the pre and post group means for the three groups on the BDI fall into the none or minimal category of depression. Despite this floor effect, the Aerobic, Stretch and Tone, and Control Group still showed a trend toward a decrease in the BDI scores after nine weeks of training (see Figure 2). The ANOVA procedure indicates this decrease to be statistically significant ($p<.015$) for all three groups (see Table 4).

Table 4

Probability Levels in Experiment #1 from a Two-Way Anova with Repeated Measures

Variable	Group Effect	Time Effect	Interaction
Aerobic Capacity	.162	.572	.130
Beck Depression Inventory	.796	.015*	.319
POMS-depression	.826	.035*	.208
vigor	.937	.644	.658
fatigue	.489	.542	.449
anger	.059	.003*	.263
tension	.432	.288	.439
confusion	.522	.038*	.652
total score	.451	.036*	.297

* denotes significance

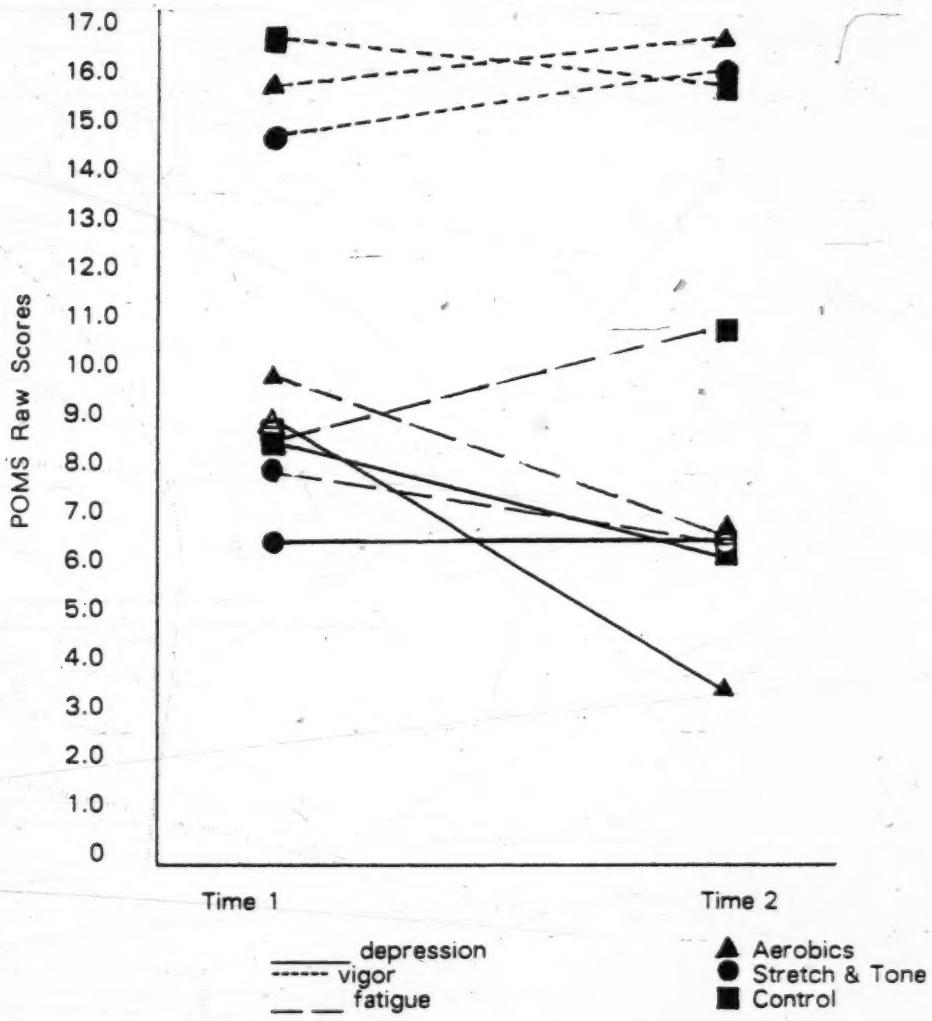

Figure 3. Results of POMS depression, vigor, and fatigue subscales

The POMS depression scores indicate the Aerobic group evidenced the greatest improvement (8.75 to 3.00), with the Control group improving somewhat (8.67 to 6.17), and the Stretch and Tone group improving very little (6.17 to 6.00). These results are statistically significant at the $p<.05$ level. See Figure 3.

The POMS vigor scores show both of the exercise groups improving somewhat from time 1 to time 2 (Aerobics 15.50 to 16.40, Stretch and Tone 14.50 to 15.92), while the Control group was less vigorous at the end of the study than at the beginning (16.33 to 15.50). There was no statistical significance between groups.

The POMS fatigue scores show both the Aerobic group (9.75 to 6.50) and the Stretch and Tone group (7.83 to 6.50) improving, while the Control group reported more fatigue at the end of the study than at the beginning (8.83 to 10.50). None of the POMS fatigue changes from pre to post was statistically significant.

The POMS anger scores indicate the Aerobic group showed the greatest decrease in anger (9.75 to 2.50) with both the Control (10.50 to 7.33) and Stretch and Tone groups (5.60 to 3.33) decreasing somewhat in anger over the nine-week study (see Figure 4). These results were statistically significant ($p<.003$).

The POMS tension scores indicate both of the exercise groups experienced a decrease in tension over time, with the Aerobic group decreasing from 10.88 to 7.88, and the Stretch and Tone group from 9.17 to 7.75, while the Control group demonstrated an increase from 11.00 to 11.67. There was no statistical significance between the three groups.

The POMS confusion scores show all three groups feeling slightly less confused at the end of the study than at the beginning. The Aerobic group improved from 7.13 to 4.63, the Stretch and Tone group from 6.50 to 5.60, and the Control group from 8.17 to 6.83. These changes from pre-test to post-test were significant for all three groups ($p<.04$).

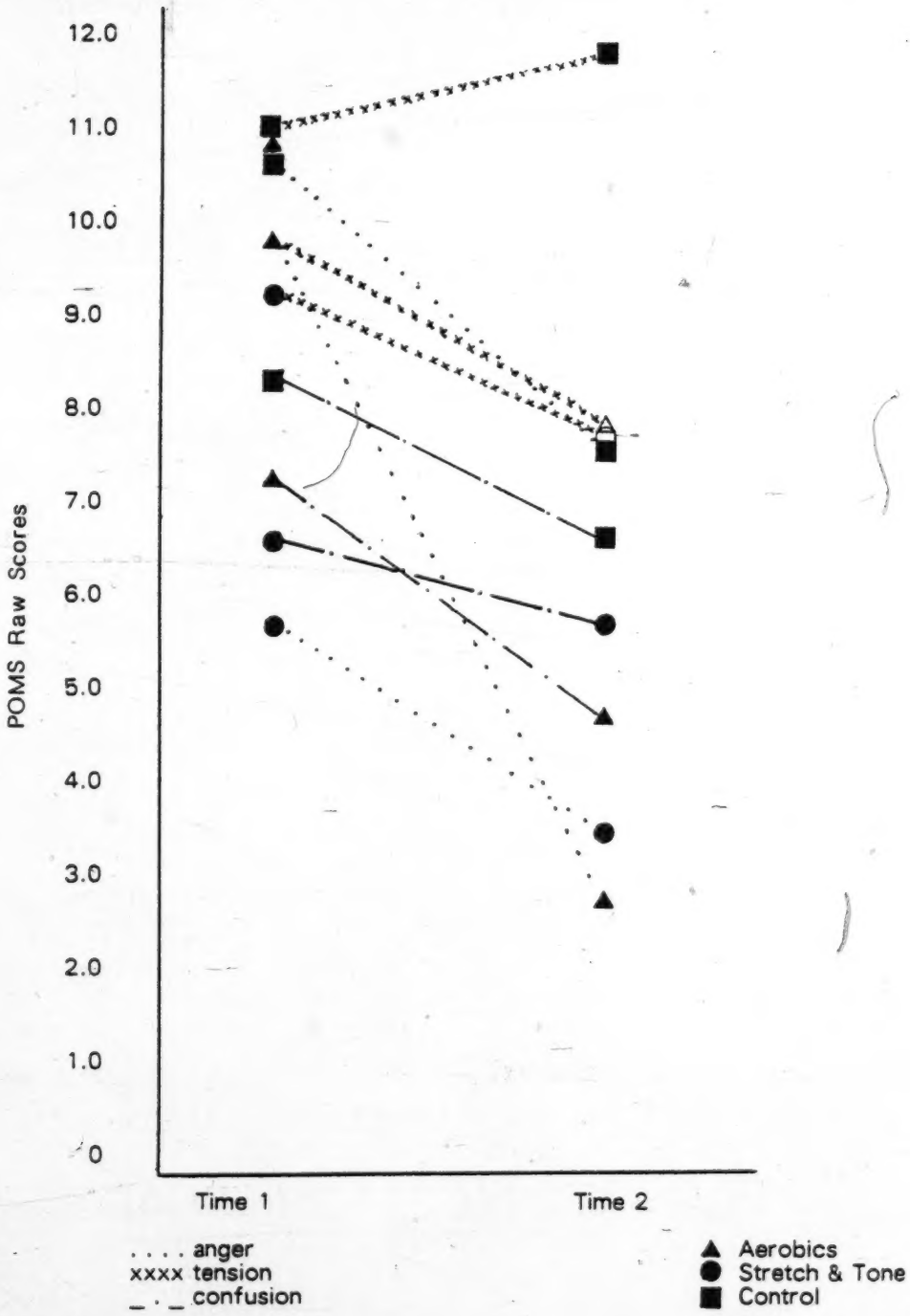

Figure 4. Results of POMS anger, tension, and confusion subscales

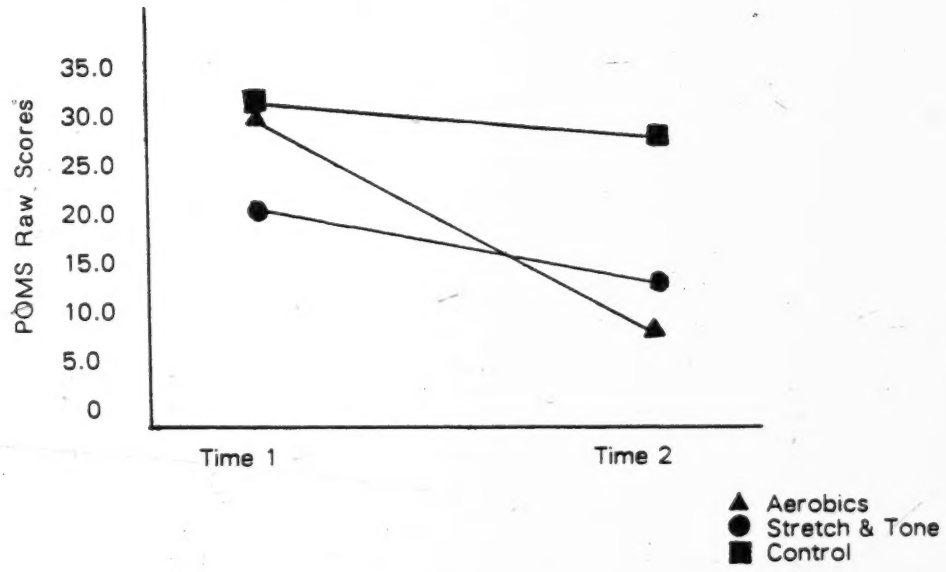

Figure 5. Results of POMS Total Score for Experiment #1

The Aerobic group showed the greatest improvement in mood state from 30.76 to 8.13, with the Stretch and Tone group improving somewhat from 20.75 to 13.25, and the Control group improving very little from 30.83 to 27.00. These changes are statistically significant ($p<.04$) from time 1 to time 2.

Table 5 summarizes the direction of the change in the dependent variables from time 1 to time 2.

Table 5

Summary of Graph Results for Experiment #1

Variable	Aerobics	Stretch and Tone	Control
Aerobic Capacity	↑	↓	↓
Beck Depression Inventory	↓	↓	↓
POMS-depression	↓	↓	↓
vigor	↑	↑	↓
fatigue	↓	↓	↑
anger	↓	↓	↓
tension	↓	↓	↑
confusion	↓	↓	↓
total score	↓	↓	↓

↑ indicates the score increased from T_1 - T_2
↓ indicates the score decreased from T_1 to T_2

Drop-Outs

A number of subjects withdrew from the study for various reasons.

Table 6

Drop-out Data for Experiment #1

	Number enrolled	Number completed	Difference
Aerobics	16	7	(-9) 56%
Stretch and Tone	29	12	(-17) 59%
Control	8	6	(-2) 25%
Total	53	25	(-28)* 53%

* 20 drop-outs, 8 data unacceptable

The percentage of subjects who did not complete the study was 53% (n=28). Of the 28 subjects classified as incomplete, 20 dropped out of the study. The reason given for withdrawal fell into one of two categories; too busy, or illness/injury unrelated to the class. Nine women withdrew due to time constraints, and 11 due to an illness or injury that was not a result of participating in the classes. All of the drop-outs were contacted by telephone and asked "Did you leave because you were not enjoying the classes?". The overwhelming majority reported liking the classes and dropping out for reasons beyond their control.

Eight women are included in the drop-out data although they did complete the study. They are included as drop-outs because their data was incomplete or unusable. Due to a problem in the instructions to the subjects on filling out the POMS, several of the subjects filled it out incorrectly.

Qualitative Data

Twenty-two subjects from the Aerobic and Stretch and Tone groups responded to the following three questions:

1. As a result of participating in the exercise classes, did you notice any changes in the way you feel about yourself?

2. If yes, what sort of changes did you notice?

3. If you noticed any changes, how significant do you feel they were?

Table 7 summarizes the responses of the data collected from the three questions given to the subjects who participated in Experiment #1. The responses were divided into eight themes or categories. The number of persons whose comments apply to a particular category appears along the bottom of each category.

The key change in the Aerobic group seemed to be an increase in stamina or energy level. All of the other response categories were approximately equal. The Stretch and Tone group reported the key change to be improved weight control and muscle tone, both of which made them happier. One-third of the Stretch and Tone group also reported an increased energy level, as well as an increase in self-confidence.

Five of seven members of the Aerobic group and 13 of 15 members of the Stretch and Tone group reported "feeling better about themselves" as a result of participating in the exercise classes.

The results of the questionnaire are discussed further in the next chapter.

B. Summary of Results: Experiment #2

Experiment #2 involved two groups (Aerobic, and Stretch and Tone), measured at time 1 (before the first fitness class of Experiment #1) and time 2 (immediately following the first fitness class of Experiment #1), and compared on changes in mood state as measured by the Profile of Mood State (POMS). The subjects were females recruited from the University of Alberta campus. The hypothesis for Experiment #2 stated that both the aerobic and non-aerobic exercise group would show an improvement in mood state as measured before and after a single exercise class.

The data for Experiment #2 was analyzed by a two-way analysis of variance (ANOVA) procedure with repeated measures on the dependent variables.

Table 7

Theme Categories for Qualitative Questionnaire from Experiment #1

	feel better about yourself	more relaxed, happier	increased confidence	slept better	better concentration	increased energy level	pride over goal mastery	improved weight loss muscle tone
Group 1 Aerobic n=7	"feel good about myself" I feel good all over"	"friends think I'm more relaxed, happier"	"increased self-confidence"	"slept a lot better"	"better able to concentrate" "increase of awareness and concentration"	"feel less tired, have more energy" "increased stamina" "higher energy level"	"pleased about finally doing something about my physical fitness"	"lost weight" "more strength" "better tone"
number	5-yes 2-unsure	2	1	1	2	5	2	2
Group 2 Stretch and Tone n=15	"felt much better about myself" "felt good after each class"	"handle stress better" "relaxation immediately following class" "immediately after class - I felt really good - relaxed, clear-headed"	"felt better about my ability to compare favorably with others in class" "felt more self-acceptance"	"needed less sleep to feel equally rested"	"more alert"	"felt a little more vigorous" "felt more energetic" "more energy" "felt exhilerated after class" "feel less sluggish"	"I had done something beneficial for myself" "felt good about participating in some type of exercise"	"feel firmer" "improved muscle tone" "more strength" "proud of increased muscle tone" "more muscle definition"
number	yes-13 sometimes-2	3	4	1	3	5	2	7

Table 8

Characteristics of Subjects in Experiment #2

	mean age (years)	occupation
Group 1 - Aerobics	30.8	9/12 (75%) students
n=12		2/12 (17%) staff
		1/12 (8%) both
Group 2 - Stretch and Tone	32.6	8/13 (62%) students
n=13		4/13 (31%) staff
		1/13 (8%) retired

Experiment #2 involved 25 subjects in one of two groups; Aerobics (n=12) and Stretch and Tone (n=13). The Aerobics group was composed of 9 students (75%), 2 staff (17%), and 1 subject classified as both student-staff. The Stretch and Tone group consisted of 8 students (62%), 4 staff (31%), and 1 subject who was retired. The two groups appear similiar in age and occupation (see Table 6). From the total number of 25 subjects in Experiment #2, 17 subjects were students (68%), 6 were staff (24%), and 2 were classified as other (8%).

Figure 6 demonstrates the dependent variables (POMS scores) changing in the predicted direction from time 1 to time 2. Both of the exercise groups became significantly less; depressed (Aerobics 10.50 to 1.50, Stretch and Tone 7.23 to 2.70, $p<.001$), fatigued (Aerobics 10.67 to 6.33, Stretch and Tone 8.31 to 6.84, $p<.01$), angry (Aerobics 10.17 to 2.00, Stretch and Tone 7.08 to 2.00, $p<.001$), tense (Aerobics 11.60 to 5.17, Stretch and Tone 9.62 to 6.08, $p<.001$), and confused (Aerobics 7.33 to 3.00, Stretch and Tone 6.31 to 4.77, $p<.001$). A significant interaction effect was noted for the confusion scores for both groups. Although both groups decreased their confusion scores as a function of time ($p<.001$), the Aerobic group showed a statistically significant greater decrease in confusion than the Stretch and Tone group ($p<.045$). Both groups also demonstrated an increase in vigor with the Aerobic group going from 14.67 to 16.17 and the Stretch and Tone from 15.00 to 16.00 (not statistically significant).

The most dramatic changes occurred in the total POMS scores. The total for the Aerobic group changed from 35.25 to 2.00. The Stretch and Tone group displayed a similar decrease from 23.54 to 7.46, indicating a strong improvement in mood state. These results are significant $p<.001$ (see Table 10). Both exercise groups exhibited a statistically significant improvement in mood state on 6 of 7 variables after participation in a single exercise class.

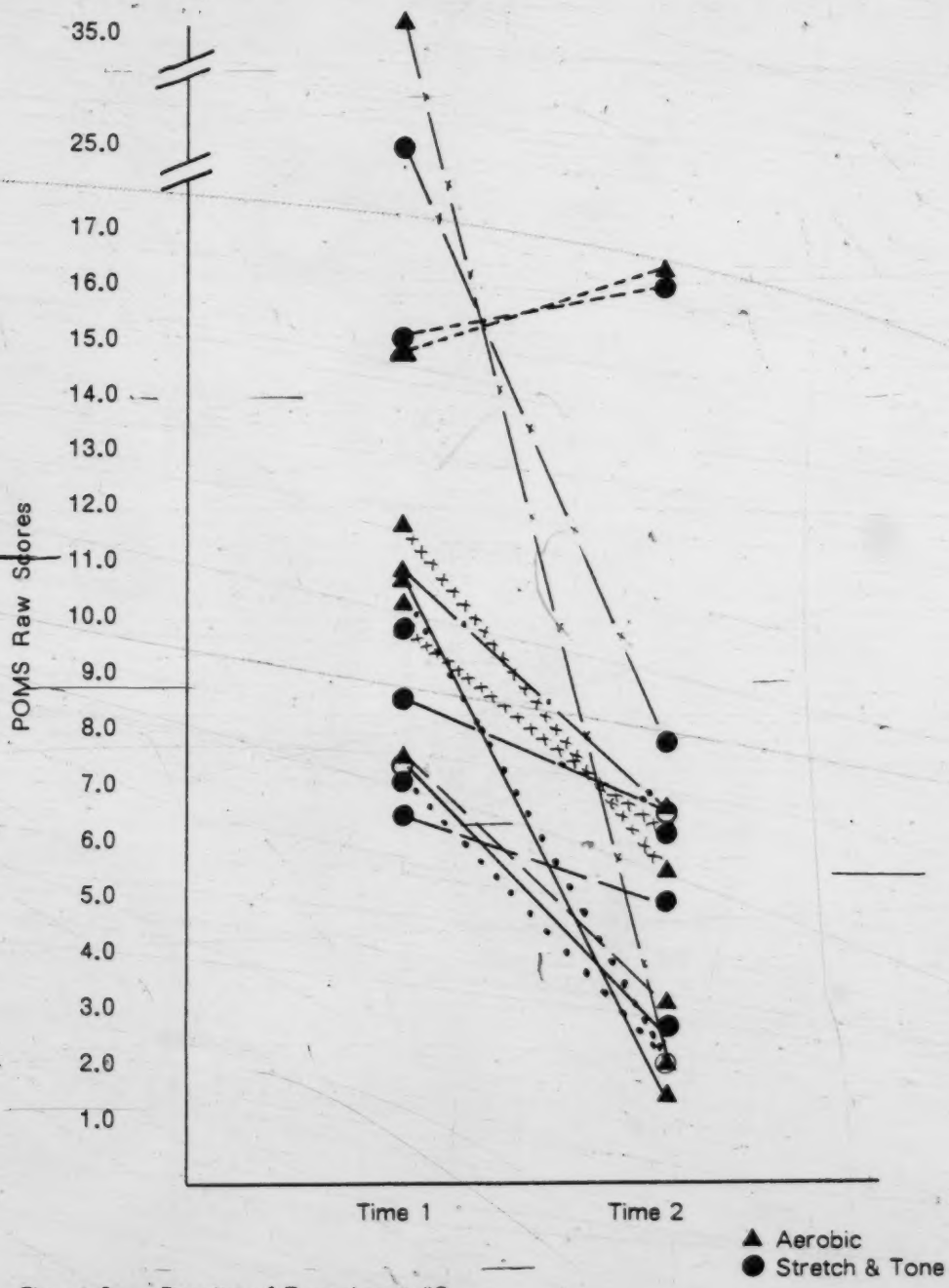

Figure 6. Results of Experiment #2

_____ depression
- - - - - - - vigor
_._._ fatigue
. . . . anger
xxxxx tension
_ _ _ confusion
___x___ total

Table 9

Summary of Results for Experiment #2

Variable	Pre (before first class)		Post (after first class)	
A. POMS+ - depression	Mean	S.E.M.*	Mean	S.E.M.
1. Aerobics	10.50	2.29	1.50	.71
2. Stretch and Tone	7.23	1.74	2.70	.65
B. POMS - vigor	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	14.67	1.52	16.17	1.13
2. Stretch and Tone	15.00	1.85	16.00	1.51
C. POMS - fatigue	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	10.67	1.43	6.33	1.49
2. Stretch and Tone	8.31	1.44	6.84	1.75
D. POMS - anger	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	10.17	1.58	2.00	1.16
2. Stretch and Tone	7.08	2.00	2.00	1.09
E. POMS - tension	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	11.60	1.73	5.17	1.27
2. Stretch and Tone	9.62	1.45	6.08	.96
F. POMS - confusion	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	7.33	1.29	3.00	.68
2. Stretch and Tone	6.31	1.00	4.77	.61
G. POMS - total	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	35.25	8.27	2.00	4.43
2. Stretch and Tone	23.54	7.40	7.46	4.01

* Standard Error of the Mean
+ Profile of Mood State

Table 10

Summary of the Results of the ANOVA (2 groups x 2 times) for Experiment #2

	Probability Levels		
Variable	Group Effect	Time Effect	Interaction
POMS			
depression	.527	.001*	.120
vigor	.966	.230	.807
fatigue	.633	.011*	.186
anger	.343	.001*	.290
tension	.733	.001*	.239
confusion	.747	.001*	.045*
total score	.684	.001*	.077

*denotes significance

C. Summary of Results: Experiment #3

Experiment #3 involved two groups (Aerobic, and Stretch and Tone), measured at time 1 (before the last fitness class of Experiment #1) and time 2 (immediately following the last fitness class of Experiment #1), and compared on changes in mood state as measured by the POMS. The subjects were females recruited from the University of Alberta campus. The hypothesis for Experiment #3 stated that both the aerobic and non-aerobic exercise group would show an improvement in mood state as measured before and after a single exercise class.

The data for Experiment #3 was analyzed by a two-way analysis of variance (ANOVA) procedure with repeated measures on the dependent variables.

Table 11

Characteristics of Subjects in Experiment #3

	mean age (years)	occupation
Group 1 - Aerobics	30.2	6/9 (66%) students
n=9		2/9 (22%) staff
		1/9 (11%) both
Group 2 - Stretch and Tone	31.4	9/13 (69%) students
n=13		3/13 (23%) staff
		1/13 (8%) retired

Experiment #3 involved 22 subjects in one of two groups; Aerobics (n=9) and Stretch and Tone (n=13). The Aerobics group had 6 students (66%), 2 staff (22%), and 1 subject classified as both student-staff (11%). The Stretch and Tone group had 9 students (69%), 3 staff (23%), and 1 subject who was retired. The two groups are similar in both mean age and occupation (see Table 11).

Figure 7 demonstrates the change in group means for the dependent variables from pre to post-test in Experiment #3. Both of the exercise groups became significantly less; depressed ($p<.001$), fatigued ($p<.004$), angry ($p<.001$), tense ($p<.001$), and confused ($p<.001$). There was also a significant change for both groups for the total score of the POMS from pre to post-test ($p<.001$). The total for the Aerobic group changed from 8.78 to -7.00. The Stretch and Tone group displayed a similar decrease from 10.92 to -0.31. Both exercise groups exhibited a statistically significant improvement in mood state on 6 of 7 variables after participation in a single exercise class.

Table 12

Summary of Results for Experiment #3

Variable	Pre (before last class)		Post (after last class)	
A. POMS+ - depression	Mean	S.E.M.*	Mean	S.E.M.
1. Aerobics	2.89	.68	0.33	.33
2. Stretch and Tone	5.54	1.90	2.31	1.03
B. POMS - vigor	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	16.33	1.46	15.56	1.54
2. Stretch and Tone	14.46	1.61	14.92	1.72
C. POMS - fatigue	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	7.22	1.29	3.11	1.23
2. Stretch and Tone	6.23	1.20	5.23	1.67
D. POMS - anger	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	3.11	1.1	0.67	.44
2. Stretch and Tone	2.92	.95	0.69	.29
E. POMS - tension	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	7.00	1.43	2.11	.48
2. Stretch and Tone	7.39	1.35	3.69	.62
F. POMS - confusion	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	4.89	.61	2.33	.47
2. Stretch and Tone	5.08	1.02	2.54	.60
G. POMS - total	Mean	S.E.M.	Mean	S.E.M.
1. Aerobics	8.78	4.03	-7.00	2.2
2. Stretch and Tone	10.92	5.98	-0.31	4.17

+ Profile of Mood State
* Standard Error of the Mean

Table 13

Summary of the Results of the ANOVA for Experiment #3

Variable	Group Effect	Time Effect	Interaction
POMS - depression	.201	.001*	.660
vigor	.537	.902	.663
fatigue	.768	.004*	.063
anger	.931	.001*	.855
tension	.408	.001*	.565
confusion	.837	.001*	.989
total score	.469	.001*	.489

* denotes significance

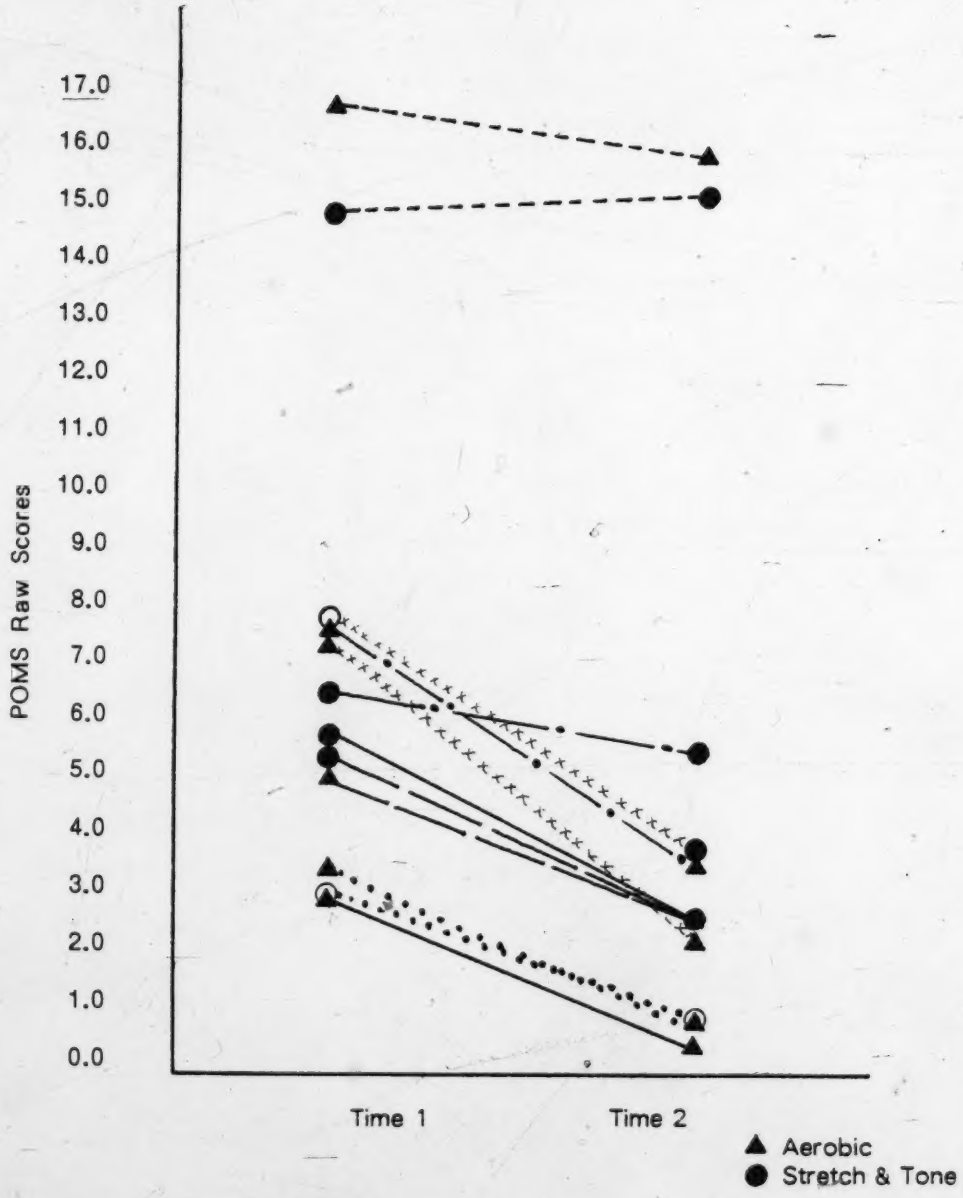

Figure 7. Results of Experiment Three

_____ depression . . . . anger
-------- vigor xxxxx tension
_._._ fatigue _ _ _ confusion

V. Discussion

This study was undertaken to investigate the relationship between two types of physical exercise; group aerobic classes, and group muscular endurance and flexibility classes, on selected psychological variables. The results of the three experiments will be discussed separately.

A. Experiment #1

The results of this study indicate that there was no statistically significant improvement in the mood state (as measured by the POMS and the BDI) for the two exercise groups when compared to the control group after nine weeks of training.

Overall, there was a statistically significant change from time 1 to time 2 on the BDI, the POMS depression, anger, confusion subscales, and the Total score of the POMS. There was no evidence of a group effect or a group by time effect.

However, several of the measures did show a trend in the expected direction. The aerobic capacity scores improved for the Aerobic group and decreased for both of the other groups. The vigor sub-scale of the POMS showed an improvement for both of the exercise groups and a decrease for the Control group. The same trend occurred for the fatigue sub-scale. The tension sub-scale showed both exercise groups becoming less tense while the control became marginally more tense from pre-test to post-test. While none of the results are statistically significant, they do tend to support the first hypothesis and previous research (Blumenthal et al., 1982; Hayden & Allen, 1984; McCann & Holmes, 1984; and Wilfley & Kunce, 1986).

The data for this experiment is questionable due to the small number of subjects in the Aerobic group (n=7) and the Control group (n=6). The problems were twofold. Twenty women withdrew from the study due to time constraints (n=9), or to illness/injury unrelated to the study (n=11). The drop-out rate had a particularly negative effect on the number of subjects remaining in the Aerobic group. Eight women were classified as drop-outs although they completed the study. Due to errors in filling out the psychological inventories, or by failing to attend the final fitness test, the data from these subject was unacceptable.

The marginal number of subjects involved in the study has a significant effect on the outcome of the statistical analysis of the data. Unfortunately, intervention studies involving human subjets are vulnerable to the unpredictability of human behavior which is beyond the experimenter's control.

Another factor that may have influenced the results is the nature of the two measures used to collect psychological data, the Beck Depression Inventory and the Profile of Mood State inventory. Both inventories were designed to measure mood state, which by definition is a transitory, highly fluctuating variable. Although both of these measures have been used in previous studies (Blumenthal et al., 1982; Hayden & Allen, 1984; Hughes et al., 1986; McCann & Holmes, 1984; Moreau, 1981; and Wilfley & Kunce, 1986), they are better suited to measuring the short-term (immediately before and after) effect of exercise on mood state than to measuring long-term intervention. For example, the instructions on the BDI are to fill out the inventory 'as you are feeling right now.'

The instructions for the use of the POMS inventory can be varied. The authors state that "to meet the demands of a particular study, other time sets can be and have been used with the POMS. Shorter rating periods such as "Today," "Right Now," and even "The Past Three Minutes" have been utilized successfully" (McNair, Lorr, and Droppleman, p. 5).

The non-random selection of the Control group may also be a factor in the outcome of the study. Unknown to the researcher at the onset of the study, all of the subjects in the control group were involved in a mild intensity movement education course at the university. While the course did not involve a systematic physical training program, the emphasis in the course on experiencing various sports may have confounded the results.

Given the methodological limitations in the study, the researcher feels strongly that the statistical analysis of results of this experiment should be accepted somewhat cautiously.

The analysis of the qualitative questionnaire filled out by the subjects in the two exercise groups revealed interesting data (see Table 6). Briefly, the results support the hypothesis that subjects would feel better as a result of a nine-week physical activity

training program. The most common themes were: 'felt better about myself,' 'increased energy level,' 'increased self-acceptance,' and 'improved physical self.'

B. Experiment #2

Experiment #2 involved two groups (Aerobic, and Stretch and Tone), measured at time 1 (before the first fitness class of Experiment #1) and time 2 (immediately following the first fitness class of Experiment #1), and compared on changes in mood state as measured by the POMS inventory. The hypothesis of Experiment #2 stated that both the aerobic and non-aerobic exercise group would show an improvement in mood state as measured before and after a single exercise class.

The results of this experiment indicate that there was a statistically significant change from time 1 to time 2 on the depression, anger, tension, fatigue, and confusion subscales of the POMS. The two groups also improved on the vigor sub-scale of the POMS (not statistically significant). The most dramatic changes occurred in the Total POMS scores. The Total score for the Aerobic group improved from 35.25 to 2.00. The Stretch and Tone group displayed a similar decrease from 23.54 to 7.46, indicating a strong improvement in mood state. Both these results are statistically significant $p<.001$.

The changes in the group means from time 1 to time 2 in Experiment #2 support the hypothesis that both of the exercise groups would show an improvement in mood state as measured before and after a single exercise class.

The short-term effect of exercise on mood state was investigated by Lichtman and Poser (1983) and Ewing and Scott (1984).

Ewing and Scott (1984) found that with 10 minutes of treadmill running, subjects who ran felt better (using the POMS as a measure) during and after the exercise than subjects who were randomly assigned to a wait-list control. Lichtman and Poser (1983) measured changes in mood state in adults who were enrolled in either a group exercise class or in various hobby classes at the YMCA (painting, photography, typing, automechanics, and nutrition). In this study, the POMS was administered prior to and upon completion of a single class. An initial difference between the two groups was found at pre-test, with the hobby group significantly more angry and depressed than the

exercise group. At post-test the exercise group was significantly less sad, fatigued, and depressed than the hobby group. The authors' cite the similar social setting and interaction available in the two groups as evidence that psychosocial factors do not operate as the sole reason for improvement in mood state in exercise studies.

It is possible that the results of Experiment #2 may be explained by the distraction or diversion hypothesis. Perhaps it is not the influence of exercise per se which influences the change in mood state but the opportunity to experience a 'time-out' from one's worries that results in an improved psychological mood. Since both exercise groups experienced a similar improvement in mood state, it is unlikely that the type of exercise (aerobic vs. muscular endurance and flexibility) influenced the change in mood state. One researcher who believes strongly that the type of exercise employed to improve mood state must be aerobic in nature is Dr. R. S. Brown. Dr. Brown, as quoted in Monahan (1986), says "the exercise must be aerobic" in order to achieve the enhanced mood state (p. 196). This may be true in long-term efforts to alleviate a clinical psychological condition with exercise. However, the results of Experiment #2, as well as Lichtman and Poser (1983), and Ewing and Scott (1984), indicate that in a non-clinical population, involvement in physical activity (regardless of initial fitness levels or changes in fitness levels in participants) may result in improvement in mood state. This data is important for people who may not exercise on a regular basis due to time constraints, physical health problems, or motivational difficulties. Often, the public is led to believe that it is only after a consistent, long-term physical training program that any improvement in psychological functioning will occur. This can be discouraging as well as a deterrant for many would-be exercisers. It is encouraging to note that the sedentary females in this study reported feeling significantly better after a single exercise class. While it may be argued that they felt good primarily as a result of beginning a long-term (nine week) committment to exercise, the results of Experiment #3 shed another light on the hypothesis.

C. Experiment #3

Although Experiment #3 was essentially conducted on a different sample from Experiment #2 because of the drop-outs that occurred between the two, both experiments were conducted from the same subject pool of Experiment #1. The hypothesis of Experiment #3 stated that both the aerobic and non-aerobic exercise group would show an improvement in mood state as measured before and after a single exercise class.

The results of Experiment #3 are similar to those of Experiment #2. There was a statistically significant change on the depression, fatigue, anger, tension, and confusion subscales after participating in a single exercise class. The pre to post improvements on the Total score of the POMS were also statistically significant.

Experiment #3 was conducted on the last day of a nine-week training program. Subjects in both groups were experienced in the exercise routines and had attended at least 80% of classes. The novelty of beginning an exercise program did not apparently affect the outcome of Experiment #3. Possibly the sense of accomplishment of having lasted the full nine weeks in the study may have accounted for the improved mood state following the last exercise class. This may have confounded the results of Experiment #3. The distraction or diversion hypothesis may also apply to Experiment #3. Both exercise groups may have felt an elevated mood state following the exercise class as a result of 'time-out' from their worries.

It was somewhat surprising to find the significant improvement in mood state in Experiment #3. Subjects in Experiment #3 were primarily students and Experiment #3 was conducted in the last week of classes in April which is a very stressful time for students. The researcher expected that the stress of studying would outweigh any positive benefits of exercising. It is encouraging to note that exercise was still beneficial in improving mood state, even under adverse conditions.

Unfortunately, a control group of non-exercising subjects was not utilized in Experiments #2 and #3.

VI. Summary and Recommendations

A. Summary

The purpose of this study was to determine the effect of two types of physical exercise (aerobic and muscular endurance/flexibility) on psychological mood state in sedentary females.

Forty-three sedentary female students and staff from the University of Alberta participated in the study. They were randomly assigned to either an Aerobics class or a Stretch and Tone class. Six of the subjects who had no intention of exercising acted as a control group.

The study looked at both the short-term and long-term effect of exercise on psychological functioning in females. The short-term effect was studied by measuring mood state changes before and after the first and last exercise class of the nine-week study. The long-term effect was measured by assessing the mood state and depression scores in the subjects prior to and immediately following a nine-week training program.

The results of the long-term study indicate that there was a statistically significant change from pre to post-test on 5 of 8 mood state variables. There was no evidence of a group effect or a group by time effect. The three other mood state variables showed a non-significant improvement for the two exercise groups and no improvement for the Control group. The results of a retrospective questionnaire indicate most subjects reported 'feeling better' about themselves after being involved in the exercise classes.

The short-term effects of exercise on mood state indicate a statistically significant improvement on 6 of 7 mood state variables after involvement in a single exercise class.

The results of both the short and long-term studies support the hypothesis that exercise has a positive influence on psychological functioning.

B. Recommendations

1. A randomly assigned control group should be used in future research of both a short-term and long-term nature.

2. A non-exercising treatment group should be included in long-term studies to control for the effects of social interaction in non-exercising subjects.

3. Further research to compare the effect of aerobic vs. non-aerobic exercise on mood state needs to be done to confirm the reliability of the data obtained in the present study.

4. Future studies could also be conducted to determine if certain types of people could benefit more than others from an exercise intervention. Contrast groups could include different personality types or different depression disorders.

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Appendix A

Beck Depression Inventory

Name _____

INSTRUCTIONS

On this questionnaire are groups of statements. Please read the entire group of statements of each category. Then pick out the one statement in that group which best describes the way you feel today, that is, right now! Circle the number beside the statement you have chosen. If several statements in the group seem to apply equally well, circle each one.
Be sure to read all the statements in each group before making your choice.

A.
3 I am so sad or unhappy that I can't stand it.
2 I am blue or sad all the time and I can't snap out of it.
1 I feel sad or blue.
0 I do not feel sad.

B.
3 I feel that the future is hopeless and that things cannot improve.
2 I feel I have nothing to look forward to.
1 I feel discouraged about the future.
0 I am not particularly pessimistic or discouraged about the future.

C.
3 I feel I am a complete failure as a person (parent, husband, wife).
2 As I look back on my life, all I can see is a lot of failures.
1 I feel I have failed more than the average person.
0 I do not feel like a failure.

D.
3 I am dissatisfied with everything.
2 I don't get satisfaction out of anything anymore.
1 I don't enjoy things the way I used to.
0 I am not particularly dissatisfied.

E.
3 I feel as though I am very bad or worthless.
2 I feel quite guilty.
1 I feel bad or unworthy a good part of the time.
0 I don't feel particularly guilty.

F.
3 I hate myself.
2 I am disgusted with myself.
1 I am disappointed in myself.
0 I don't feel disappointed in myself.

G.
3 I would kill myself if I had the chance.
2 I have definite plans about committing suicide.
1 I feel I would be better off dead.
0 I don't have any thoughts of harming myself.

H.
3 I have lost all of my interest in other people and don't care about them at all.
2 I have lost most of my interest in other people and have little feeling for them.
1 I am less interested in other people than I used to be.
0 I have not lost interest in other people.

I.
3 I can't make any decisions at all anymore.
2 I have great difficulty in making decisions.
1 I try to put off making decisions.
0 I make decisions about as well as ever.

J.
3 I feel that I am ugly or repulsive-looking.
2 I feel that there are permanent changes in my appearance and they make me look unattractive.
1 I am worried that I am looking old or unattractive.
0 I don't feel that I look any worse than I used to.

K.
3 I can't do any work at all.
2 I have to push myself very hard to do anything.
1 It takes extra effort to get started at doing something.
0 I can work about as well as before.

L.
3 I get too tired to do anything.
2 I get tired from doing anything.
1 I get tired more easily than I used to.
0 I don't get any more tired than usual.

M.
3 I have no appetite at all anymore.
2 My appetite is much worse now.
1 My appetite is not as good as it used to be.
0 My appetite is no worse than usual.

Appendix B

Profile of Moods States

Name _____

POMS Instructions:

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE space under the answer to the right which best describes HOW YOU ARE FEELING RIGHT NOW.

The numbers refer to these phrases:

1 = Not at all
2 = A little
3 = Moderately
4 = Quite a bit
5 = Extremely

1.	Friendly	1	2	3	4	5
2.	Tense	1	2	3	4	5
3.	Angry	1	2	3	4	5
4.	Worn out	1	2	3	4	5
5.	Unhappy	1	2	3	4	5
6.	Clear-headed	1	2	3	4	5
7.	Lively	1	2	3	4	5
8.	Confused	1	2	3	4	5
9.	Sorry for things done	1	2	3	4	5
10.	Shaky	1	2	3	4	5
11.	Listless	1	2	3	4	5
12.	Peeved	1	2	3	4	5
13.	Considerate	1	2	3	4	5
14.	Sad	1	2	3	4	5
15.	Active	1	2	3	4	5
16.	On edge	1	2	3	4	5
17.	Grouchy	1	2	3	4	5

18.	Blue	1	2	3	4	5
19.	Energetic	1	2	3	4	5
20.	Panicky	1	2	3	4	5
21.	Hopeless	1	2	3	4	5
22.	Relaxed	1	2	3	4	5
23.	Unworthy	1	2	3	4	5
24.	Spiteful	1	2	3	4	5
25.	Sympathetic	1	2	3	4	5
26.	Uneasy	1	2	3	4	5
27.	Restless	1	2	3	4	5
28.	Unable to concentrate	1	2	3	4	5
29.	Fatigued	1	2	3	4	5
30.	Helpful	1	2	3	4	5
31.	Annoyed	1	2	3	4	5
32.	Discouraged	1	2	3	4	5
33.	Resentful	1	2	3	4	5
34.	Nervous	1	2	3	4	5
35.	Lonely	1	2	3	4	5
36.	Miserable	1	2	3	4	5
37.	Muddled	1	2	3	4	5
38.	Cheerful	1	2	3	4	5
39.	Bitter	1	2	3	4	5
40.	Exhausted	1	2	3	4	5
41.	Anxious	1	2	3	4	5
42.	Ready to fight	1	2	3	4	5
43.	Good natured	1	2	3	4	5

44.	Gloomy	1	2	3	4	5
45.	Desperate	1	2	3	4	5
46.	Sluggish	1	2	3	4	5
47.	Rebellious	1	2	3	4	5
48.	Helpless	1	2	3	4	5
49.	Weary	1	2	3	4	5
50.	Bewildered	1	2	3	4	5
51.	Alert	1	2	3	4	5
52.	Deceived	1	2	3	4	5
53.	Furious	1	2	3	4	5
54.	Efficient	1	2	3	4	5
55.	Trusting	1	2	3	4	5
56.	Full of pep	1	2	3	4	5
57.	Bad-tempered	1	2	3	4	5
58.	Worthless	1	2	3	4	5
59.	Forgetful	1	2	3	4	5
60.	Carefree	1	2	3	4	5
61.	Terrified	1	2	3	4	5
62.	Guilty	1	2	3	4	5
63.	Vigorous	1	2	3	4	5
64.	Uncertain about things	1	2	3	4	5
65.	Bushed	1	2	3	4	5

Appendix C

Life Events Survey

Listed below are a number of events which sometimes bring about change in the lives of those who experience them and which necessitate social readjustment. Please check those events which you have experienced in the recent past and indicate the time period during which you have experienced each event. Be sure that all check marks are directly across from the items they correspond to.

Also, for each item checked below, please indicate the extent to which you viewed the event as having either a positive or negative impact on your life at the time the event occurred. That is, indicate the type and extent of impact that the event had. A rating of -3 would indicate an extremely negative impact. A ration of 0 suggests no impact either positive or negative. A rating of +3 would indicate an extremely positive impact.

Section 1

Event	0 to 6 mo	7 mo to 1 yr	Extremely negative	Moderately negative	Somewhat negative	No impact	Slightly positive	Moderately positive	Extremely positive
1. Marriage			-3	-2	-1	0	+1	+2	+3
2. Detention in jail or comparable institution			-3	-2	-1	0	+1	+2	+3
3. Death of spouse			-3	-2	-1	0	+1	+2	+3
4. Major change in sleeping habits (much more or much less sleep)			-3	-2	-1	0	+1	+2	+3
5. Death of close family member:			-3	-2	-1	0	+1	+2	+3
a. Mother			-3	-2	-1	0	+1	+2	+3
b. Father			-3	-2	-1	0	+1	+2	+3
c. Brother			-3	-2	-1	0	+1	+2	+3
d. Sister			-3	-2	-1	0	+1	+2	+3
e. Grandmother			-3	-2	-1	0	+1	+2	+3
f. Grandfather			-3	-2	-1	0	+1	+2	+3
g. Other (specify)			-3	-2	-1	0	+1	+2	+3
6. Major change in eating habits (much more or much less food intake)			-3	-2	-1	0	+1	+2	+3
7. Foreclosure on mortgage or loan			-3	-2	-1	0	+1	+2	+3
8. Death of close friend			-3	-2	-1	0	+1	+2	+3
9. Outstanding personal achievement			-3	-2	-1	0	+1	+2	+3
10. Minor law violations (traffic tickets, disturbing the peace)			-3	-2	-1	0	+1	+2	+3
11. Male: Wife/girlfriend's pregnancy			-3	-2	-1	0	+1	+2	+3
12. Female: Pregnancy			-3	-2	-1	0	+1	+2	+3
13. Changed work situation (different work responsibility, major change in working conditions, working hours, etc.)			-3	-2	-1	0	+1	+2	+3

Event	0 to 6 mo	7 mo to 1 yr	Extremely negative	Moderately negative	Somewhat negative	No impact	Slightly positive	Moderately positive	Extremely positive
14. New job			-3	-2	-1	0	+1	+2	+3
15. Serious illness or injury of close family member:									
a. Father			-3	-2	-1	0	+1	+2	+3
b. Mother			-3	-2	-1	0	+1	+2	+3
c. Sister			-3	-2	-1	0	+1	+2	+3
d. Brother			-3	-2	-1	0	+1	+2	+3
e. Grandfather			-3	-2	-1	0	+1	+2	+3
f. Grandmother			-3	-2	-1	0	+1	+2	+3
g. Spouse			-3	-2	-1	0	+1	+2	+3
h. Other (specify)			-3	-2	-1	0	+1	+2	+3
16. Sexual difficulties			-3	-2	-1	0	+1	+2	+3
17. Trouble with employer (in danger of losing job, being suspended, demoted, etc.)			-3	-2	-1	0	+1	+2	+3
18. Trouble with in-laws			-3	-2	-1	0	+1	+2	+3
19. Major change in financial status (a lot better off or a lot worse off)			-3	-2	-1	0	+1	+2	+3
20. Major change in closeness of family members (increased or decreased closeness)			-3	-2	-1	0	+1	+2	+3
21. Gaining a new family member (through birth, adoption, family member moving in, etc.)			-3	-2	-1	0	+1	+2	+3
22. Change of residence			-3	-2	-1	0	+1	+2	+3
23. Marital separation from mate			-3	-2	-1	0	+1	+2	+3
24. Major change in church activities (increased or decreased attendance)			-3	-2	-1	0	+1	+2	+3
25. Marital reconciliation with mate			-3	-2	-1	0	+1	+2	+3
26. Major change in number of arguments with spouse (a lot more or a lot less arguments)			-3	-2	-1	0	+1	+2	+3
27. Married male: Change in wife's work outside the home (beginning work, ceasing work, changing to a new job, etc.)			-3	-2	-1	0	+1	+2	+3
28. Married female: Change in husband's work (loss of job, beginning new job, retirement, etc.)			-3	-2	-1	0	+1	+2	+3
29. Major change in usual type and/or amount of recreation			-3	-2	-1	0	+1	+2	+3
30. Borrowing more than $10,000 (buying home, business, etc.)			-3	-2	-1	0	+1	+2	+3
31. Borrowing less than $10,000 (buying car, TV, getting school loan, etc.)			-3	-2	-1	0	+1	+2	+3

Event	0 to 6 mo	7 mo to 1 yr	Extremely negative	Moderately negative	Somewhat negative	No impact	Slightly positive	Moderately positive	Extremely positive
32. Being fired from job			-3	-2	-1	0	+1	+2	+3
33. Male: Wife/girlfriend having abortion			-3	-2	-1	0	+1	+2	+3
34. Female: Having abortion			-3	-2	-1	0	+1	+2	+3
35. Major personal illness or injury			-3	-2	-1	0	+1	+2	+3
36. Major change in social activities, e.g., parties, movies, visiting increased or decreased participation)			-3	-2	-1	0	+1	+2	+3
37. Major change in living conditions of family (building new home, remodeling, deteriorating of home, neighborhood, etc.)			-3	-2	-1	0	+1	+2	+3
38. Divorce			-3	-2	-1	0	+1	+2	+3
39. Serious injury or illness of close friend			-3	-2	-1	0	+1	+2	+3
40. Retirement from work			-3	-2	-1	0	+1	+2	+3
41. Son or daughter leaving home (due to marriage, college, etc.)			-3	-2	-1	0	+1	+2	+3
42. Ending of formal schooling			-3	-2	-1	0	+1	+2	+3
43. Separation from spouse (due to work, travel, etc.)			-3	-2	-1	0	+1	+2	+3
44. Engagement			-3	-2	-1	0	+1	+2	+3
45. Breaking up with boyfriend/ girlfriend			-3	-2	-1	0	+1	+2	+3
46. Leaving home for the first time			-3	-2	-1	0	+1	+2	+3
47. Reconciliation with boyfriend/ girlfriend			-3	-2	-1	0	+1	+2	+3
Other recent experiences which have had an impact on your life.									
48. _____			-3	-2	-1	0	+1	+2	+3
49. _____			-3	-2	-1	0	+1	+2	+3
50. _____			-3	-2	-1	0	+1	+2	+3
Section II Student only									
51. Beginning a new school experience at a higher academic level (college, graduate school, professional school, etc.)			-3	-2	-1	0	+1	+2	+3
52. Changing to a new school at same academic level (undergraduate, graduate, etc.)			-3	-2	-1	0	+1	+2	+3
53. Academic probation			-3	-2	-1	0	+1	+2	+3

Appendix D

PLEASE ANSWER THE FOLLOWING QUESTIONS. BE AS BRIEF OR AS IN-DEPTH AS YOU WANT.

1) AS A RESULT OF PARTICIPATING IN THE EXERCISE CLASSES, DID YOU NOTICE ANY CHANGES IN THE WAY YOU FEEL ABOUT YOURSELF?

2) IF YES, WHAT SORT OF CHANGES DID YOU NOTICE?

3) IF YOU NOTICED ANY CHANGES, HOW SIGNIFICANT DO YOU FEEL THEY WERE?

THANK-YOU, CM

Appendix E

Anova Summary Tables

Anova Summary Tables Experiment #1

Aerobic Capacity

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	399.776	2.	199.888	1.982	0.162
S-Within	2218.305	22.	100.832		
B Time	6.055	1.	6.055	0.329	0.572
AB	82.628	2.	41.314	2.243	0.130
BS-Within	405.258	22.	18.421		

Beck Depression Inventory

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	11.977	2.	5.988	0.230	0.796
S-Within	599.313	23.	26.057		
B Time	25.521	1.	25.521	6.921	0.015*
AB	8.847	2.	4.424	1.200	0.319
BS-Within	84.813	23.	3.688		

POMS - Depression Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	22.389	2.	11.194	0.193	0.826
S-Within	1335.000	23.	58.043		
B Time	94.452	1.	94.452	5.048	0.035*
AB	62.908	2.	31.454	1.681	0.208
BS-Within	430.333	23.	18.710		

POMS - Fatigue Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	50.908	2.	25.454	0.738	0.489
S-Within	792.750	23.	34.467		
B Time	11.342	1.	11.342	0.383	0.542
AB	49.129	2.	24.564	0.829	0.449
BS-Within	681.750	23.	29.641		

POMS - Vigor Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	5.516	2.	2.758	0.065	0.937
S-Within	975.316	23.	42.405		
B Time	2.836	1.	2.836	0.219	0.644
AB	11.031	2.	5.516	0.427	0.658
BS-Within	297.313	23.	12.927		

POMS - Anger Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	162.389	2.	81.194	3.211	0.059
S-Within	581.625	23.	25.288		
B Time	213.926	1.	213.926	10.690	0.003*
AB	56.683	2.	28.342	1.416	0.263
BS-Within	460.292	23.	20.013		

POMS - Tension Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	69.020	2.	34.510	0.871	0.432
S-Within	910.879	23.	39.603		
B Time	18.750	1.	18.750	1.184	0.288
AB	27.055	2.	13.527	0.854	0.439
BS-Within	364.125	23.	15.832		

POMS - Confusion Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	25.574	2.	12.787	0.668	0.522
S-Within	440.208	23.	19.139		
B Time	30.083	1.	30.083	4.868	0.038*
AB	5.387	2.	2.693	0.436	0.652
BS-Within	142.125	23.	6.179		

POMS - Total Score Experiment One

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	1268.283	2.	634.142	0.824	0.451
S-Within	17693.855	23.	769.298		
B Time	1537.559	1.	1537.559	4.959	0.036*
AB	793.781	2.	396.891	1.280	0.297
BS-Within	7131.855	23.	310.081		

Anova Summary Tables Experiment #2

POMS - Depression Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	13.458	1.	13.458	0.412	0.527
S-Within	750.462	23.	32.629		
B Time	571.865	1.	571.865	24.062	0.001*
AB	62.105	1.	62.105	2.613	0.120
BS-Within	546.615	23.	23.766		

POMS - Vigor Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	0.088	1.	0.088	0.002	0.966
S-Within	1065.836	23.	46.341		
B Time	19.500	1.	19.500	1.523	0.230
AB	0.780	1.	0.780	0.061	0.807
BS-Within	294.500	23.	12.804		

POMS - Fatigue Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	10.634	1.	10.634	0.234	0.633
S-Within	1046.846	23.	45.515		
B Time	104.773	1.	104.773	7.555	0.011
AB	25.731	1.	25.731	1.855	0.186
BS-Within	318.949	23.	13.867		

POMS - Anger Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	29.785	1.	29.785	0.937	0.343
S-Within	731.295	23.	31.795		
B Time	547.225	1.	547.225	21.578	0.001
AB	29.785	1.	29.785	1.174	0.290
BS-Within	583.295	23.	25.361		

POMS - Tension Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	3.489	1.	3.489	0.119	0.733
S-Within	674.510	23.	29.327		
B Time	309.206	1.	309.206	17.513	0.001
AB	25.847	1.	25.847	1.464	0.239
BS-Within	406.074	23.	17.655		

POMS - Confusion Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	1.725	1.	1.725	0.107	0.747
S-Within	370.795	23.	16.122		
B Time	107.571	1.	107.571	19.801	0.001
AB	24.371	1.	24.371	4.486	0.045
BS-Within	124.949	23.	5.433		

POMS - Total Score

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	121.875	1.	121.875	0.170	0.684
S-Within	16470.125	23.	716.092		
B Time	7591.414	1.	7591.414	28.241	0.001
AB	920.135	1.	920.135	3.423	0.077
BS-Within	6182.590	23.	268.808		

Anova Summary Tables Experiment #3

POMS - Depression Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	56.853	1.	56.853	1.750	0.201
S-Within	649.624	20.	32.481		
B Time	89.031	1.	89.031	14.684	0.001*
AB	1.212	1.	1.212	0.200	0.660
BS-Within	121.265	20.	6.063		

POMS - Vigor Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	16.676	1.	16.676	0.394	0.537
S-Within	846.984	20.	42.349		
B Time	0.267	1.	0.267	0.015	0.902
AB	4.085	1.	4.085	0.235	0.633
BS-Within	347.395	20.	17.370		

POMS - Fatigue Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	3.385	1.	3.385	0.089	0.768
S-Within	758.615	20.	37.931		
B Time	69.465	1.	69.465	10.490	0.004*
AB	25.737	1.	25.737	3.887	0.063
BS-Within	132.445	20.	6.622		

POMS - Anger Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	0.070	1.	0.070	0.008	0.931
S-Within	183.316	20.	9.166		
B Time	58.121	1.	58.121	16.311	0.001*
AB	0.122	1.	0.122	0.034	0.855
BS-Within	71.265	20.	3.563		

POMS - Tension Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	10.276	1.	10.276	0.714	0.408
S-Within	287.906	20.	14.395		
B Time	195.807	1.	195.807	17.575	0.001*
AB	3.808	1.	3.808	0.342	0.565
BS-Within	222.829	20.	11.141		

POMS - Confusion Subscale

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	0.411	1.	0.411	0.043	0.837
S-Within	190.316	20.	9.516		
B Time	69.001	1.	69.001	19.512	0.001*
AB	0.001	1.	0.001	0.000	0.989
BS-Within	70.727	20.	3.536		

POMS - Total Score

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
A Group	207.684	1.	207.684	0.545	0.469
S-Within	7617.316	20.	380.866		
B Time	1939.705	1.	1939.705	17.507	0.001*
AB	54.977	1.	54.977	0.496	0.489
BS-Within	2215.930	20.	110.796		